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Access to Healthy Foods: A Descriptive Analysis of Farmers' Markets, Food Deserts & USDA Food Assistance Programs in Tennessee Census Tracts

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by

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ABSTRACT

Access to Healthy Foods: A Descriptive Analysis of Farmers' Markets, Food Deserts & USDA Food Assistance Programs in Tennessee Census Tracts

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Food deserts are a growing problem in the United States, and occur in areas of low-income where people have limited access to healthy foods. In response, the presence of farmers' markets has grown exponentially, and improved healthy food access. Additionally, the USDA has strived to connect families to healthy foods through food assistance programs such as the Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the Senior Farmers' Market Nutrition Program (SFMNP). This study investigated the relationship between farmers' markets, their acceptance of food assistance benefits, and their locations within Tennessee food deserts census tracts.

Using the 2017 Farmers' Market Directory, this study merged market data, including geocoded addresses, with the appropriate census tract data from the 2015 Food Access Research Atlas. Chi-square tests of independence and spatial visualizations were used to assess the relationship of census tracts, farmers markets, and food assistance benefits.

Of the 1,497 Tennessee census tracts, 18.0% were food deserts. Of these food deserts, 9.3% had at least one market present. Of these food deserts, 92.0% were urban. Of 130 farmers' markets in Tennessee, 34.6% accepted any food assistance benefits. Additionally, 56.9% of all markets were in areas of high socioeconomic status (SES).

Results indicated that markets were clustered in urban areas, and few were identified as food deserts. Additionally, few markets were in food deserts and accepted any food assistance benefit. Due to these findings, the definition of food deserts should be expanded to include additional food retailers other than supermarkets. Also, additional policies and research is needed to reinforce farmers' markets and food assistance programs as food access interventions.

DEDICATION

To my parents: Thanks for the “extra” push.

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LIST OF ABBREVIATIONS

Agriculture Adjustment Act (AAA)

Electronic Benefits Transfer card (EBT)

Food Desert Relief Enterprises (FDRE)

Food Stamp Program (FSP)

Healthy Food Financing Initiatives (HFFI)

Health Impact Assessment (HIA)

United States Department of Agriculture (USDA)

The Farmers' Market Nutrition Program (FMNP)

The Senior Farmer's Market Nutrition Program (SFMNP)

The Supplemental Nutrition Assistance Program (SNAP)

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

CHAPTER 1

INTRODUCTION

Background

Obesity and overweight are significant public health issues which can increase a person's risk of developing hypertension, heart disease, diabetes, stroke, certain cancers and other disorders (Çakmur, 2017). The prevalence of overweight and obesity continues to increase in all countries, among every age group, and among children and adults. Although there is no single cause for these increases, lack of physical activity and improper nutrition contributes to increased rates (Ahn et al., 2014). Research has also shown that limited access to supermarkets, grocery stores, farmers' markets, and other sources of healthy and affordable food options often makes it difficult for many individuals, specifically those living in low-income, low-access communities, to maintain a healthy diet (Bell, Mora, Hagan, Rubin, & Karpyn, 2013; Flournoy, 2006; Seligman, Laraia, & Kushel, 2010; Treuhaft & Karpyn, 2013). These low-income, low-access communities are often referred to as "food deserts". The United States Department of Agriculture (USDA) (2016) defines food deserts as census tracts with a substantial number of residents who lack access to fresh fruits, vegetables, and other healthy foods due to the absence of healthy food retailers. Instead of supermarkets and grocery stores, these communities may only have access to fast food restaurants and convenience stores, which tend to offer few healthy, affordable food options. Additionally, individuals who reside in foods deserts may also have limited resources, such as income, a personal vehicle, or access to public transportation (United States Department of Agriculture, 2016b). For a census tract to be considered a food desert by USDA standards, two factors must occur: (1) at least 33.0% of the tract's population or a

minimum of 500 people in the tract must have low access to a supermarket or large grocery store, and (2) a low-income census tract is defined as any census tract where the poverty rate for that tract is at least 20.0%, or for tracts not located within a metropolitan area, the median family income for the tract does not exceed 80% of statewide median family income (United States Department of Agriculture, 2017e; Ploeg et al., 2012). These factors often make it difficult for residents of food deserts to acquire healthy options for consumption.

The issue of food deserts within the United States is not to be taken lightly. In 2012, the Economic Research Service (ERS) reported that approximately 29.7 million people (23.5 million in 2000) lived in food deserts (Ploeg, 2010; Ploeg et al., 2012). This 6.2 million increase between 2000 and 2012 was attributed to the growing number of low income communities and lack of grocery store or supermarket openings in declared food deserts (Ploeg, 2010). In 2016, approximately 18.9% of United States residents who were low-income also had decreased access to food (Feeding America, 2017b). Unfortunately, this rate was higher in Tennessee, in which approximately 24.1% of the low-income population had decreased access to food in 2016 (Feeding America, 2017b). Further, over 3.1 million Tennessee residents lived in food deserts, of whom 1.1 million, including 300,000 children, were food insecure that same year (Feeding America, 2017b).

The structure of a food environment has a profound effect on the health of residents (Hinrichs, Lyson, & Guptill, 2007; Jilcott et al., 2011; Morland, Diez Roux, & Wing, 2006; Morland & Evenson, 2009). Approximately 70.7% of U.S. adults aged 20 years and over were considered overweight or obese in 2013-2014 (National Center for Health Statistics, 2016). During those same years, 20.6% of youth in the U.S. were classified as obese (National Center

for Health Statistics, 2016). Tennessee's obesity rate is even more staggering. The state now has the ninth highest adult obesity rate in the nation (US rate is 38.0%), with the adult obesity rate currently at 33.8%, an increase from 2000 (20.9%) and 1990 (11.1%) (Segal, Martín, & Rayburn, 2016).

High obesity rates are attributed, at least in part, to food insecurity and the limited intake of fruits and vegetables (Hossfeld, Kelly, Smith, & Waity, 2015). This is especially true of individuals who reside in low-income communities, thereby increasing their risks of chronic diseases (Giang, Karpyn, Laurison, Hillier, & Perry, 2008). For example, research has shown that residential proximity to a grocery store, supermarket, farmers' market or other food retail outlets was linked to the increased intake of fruits and vegetables and positive health outcomes (McGuire, 2013; Sharkey, 2009; Treuhaft & Karpyn, 2013). Specifically, farmers' markets have advanced as a strategy to improve access to healthy foods. A farmers' market is a public and recurring assembly of two or more farmers or producers who sell their own produce directly to the general public at a fixed location (United States Department of Agriculture, 2016a). More than often, farmers' markets do not require permanent structures, making them a good strategy to improve food accessibility and availability. Due to this, farmers' markets are located in areas with limited access to healthy foods (Boos, 2012). In recent years, farmers' markets have become an alternative to purchasing goods from grocery stores or supermarkets, whose produce more than often come from major wholesalers and distributors (Alkon, 2008). This makes farmers' markets valuable because they are quicker to implement than new store development (United States Department of Agriculture, 2017a). Furthermore, farmers' markets make healthy foods available to those living in food deserts, assist in lowering the cost of foods, and provide better options to maintain a healthy diet (Ahn et al., 2014; Mccracken, Sage, & Sage, 2012).

According to the USDA's Dietary Guidelines for Americans, a healthy diet must contain at least five servings of fruits and vegetables as well as a variety of lean proteins and whole grains per day (DeSalvo, Olson, & Casavale, 2016). However, despite these recommendations, the average individual over consumes calories, sodium, sugars, fats, and under-consumes options for optimum health (DeSalvo et al., 2016). This is particularly evident among those who live in low-income, low-access areas (food deserts). Research has shown that price is critical to low-income consumers in comparison to high-income consumers, and to non-white consumers in comparison to white consumers (Darcey & Quinlan, 2009). For example, healthy foods are generally more expensive than foods that are high in fat and sugar, especially within low-income, minority communities (Mccracken et al., 2012). Therefore, multi-level policies and interventions such as federal food assistance programs have been implemented to increase food access and reduce food insecurity (Gundersen, Kreider, & Pepper, 2011; Krukowski, Boozman, West, Harvey-Berino, & Prewitt, 2010; Young, Karpyn, Uy, Wich, & Glyn, 2011). It is important to note that food insecurity only exists when "the availability of adequate nutritious and safe foods, or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain" (National Research Council (US), 2006:43). Food insecurity is also correlated with adverse health outcomes, a higher prevalence of inadequate intake of important nutrients, and risk of overweight and obesity (Darcey & Quinlan, 2009; Eicher-Miller, Mason, Abbott, McCabe, & Boushey, 2009; United States Department of Agriculture, 2016b).

Significance of Research

Many studies have shown that the lack of access to healthy, affordable foods is an underlying cause of obesity, overweight, and diet-related chronic diseases (Bodor, Rice, Farley,

Swalm, & Rose, 2010; de Onis, 2015; Larson, Story, & Nelson, 2009; Mccoubrey et al., 2010; Michimi & Wimberly, 2010; Rundle et al., 2009). Therefore, eliminating food deserts and increasing consistent access to these foods have become priorities for both local and national public health policy (Gundersen, 2013; Jiao, Moudon, Ulmer, Hurvitz, & Drewnowski, 2012; Johnson & Monke, 2017; Young et al., 2011).

In recent years, research has begun to focus more on the presence of farmers' markets in food deserts by utilizing spatial analyses to investigate disparities in access to healthy foods, and providing evidence of how federal food assistance programs support and offer benefits to both consumers and farmers (Anderson & Burau, 2015; Berry, 2013; Boos, 2012; Brace, Matthews, Finkelstein, & Beall, 2016; Davis, 2009; Schmitz, 2010; Waity, 2016; Wang, Qiu, & Swallow, 2014; Yanamandra, Maienschein, Wharton, & Ellison, 2015). Specifically, spatial analyses found that increasing the number of fresh food outlets (i.e. farmers' markets) improved healthy food accessibility, especially in urban neighborhoods (Anderson & Burau, 2015; Wang et al., 2014). It was also found that farmers' markets were more likely to be located in urban areas where public transportation, walking and biking were utilized as viable traveling options (Berry, 2013; Brace et al., 2016; Davis, 2009; Schmitz, 2010). Additionally, farmers' markets located in rural, high-poverty areas (census tracts) were less likely to accept benefits from food assistance programs in comparison to urban, high-poverty areas (census tracts) (Mccracken et al., 2012; Waity, 2016). Furthermore, individuals who lived in close proximity to a farmers' market were more likely to purchase foods from a farmers' markets and had a relatively lower income (Boos, 2012). Lastly, research found that farmers' markets tended to be located in areas of high unemployment rates and low educational attainment (Wang et al., 2014).

Not only do farmers' markets present opportunities to producers and consumers, multi-level governments can make specific cost-effective investments to improve community health, increase diversity, and promote entrepreneurship. To achieve such goals, public health professionals and cardiovascular disease prevention advocates have explored and implemented a range of policies and initiatives to expand and improve access to healthy foods in various food retail environments, workplaces, and schools. Key policies and initiatives have addressed land use planning and zoning, local permits and licensing, food procurement opportunities, financing and tax incentives, and healthy food policies (Public Health Law Center, 2012). For example, the USDA currently allows farmers' markets to accept benefits from the Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and the Senior Farmers' Market Nutrition Program (SFMNP). When markets accept such benefits, they become more appealing to all residents of a community. Additionally, accepting such benefits at farmers' markets can also stimulate the local economy, in which money spent can be redistributed into the community (National Sustainable Agriculture Coalition, 2016). Although such policies and initiatives are beneficial, access to healthy foods is still a public health issue, specifically within food deserts.

Research on food deserts, food security, and farmers' markets has been ongoing (Alkon, 2008; Beaulac, Kristjansson, & Cummins, 2009; Franklin et al., 2012); however, only over the last decade has research begun to investigate how methods of food distribution (i.e. corner stores, bodegas, and farmers' markets) other than grocery stores or supermarkets alleviate food deserts and food insecurity. Research has focused on the understanding of food deserts and community perceptions of food distribution methods, yet there is limited research on farmers' markets and their acceptance of government food assistance benefits in food deserts (Gatrell, Reid, & Ross,

2011). Such representation of farmers' markets, food deserts, and government food assistance programs in research would allow for a better understanding of whether funds should be continually allocated for the integration of food assistance programs in farmers' markets.

One method to examine the kinds of resources a community might use to address food insecurity is through the development of spatial visualizations using geographic information system (GIS) analysis. Unfortunately, spatial visualizations have not shown the distribution of farmers' markets and food assistance programs within food deserts. These visualizations are important in understanding what resources are available to those who live in food deserts, and are the first steps towards additional analysis and expansion of access to healthy foods. For example, this information, when tied with demographic and socioeconomic data, can track the success of food access policies and initiatives targeting populations to improve healthy food access and overall health within food deserts. Moreover, this information can be used to establish more accessible healthy food retailers. Currently, such spatial visualizations of farmers' markets, their acceptance of food assistance benefits, and proximity to food deserts does not exist for the state of Tennessee. In addition to the lack of farmers' markets and food desert mapping in Tennessee, there has not been any enacted local food system legislation when addressing local foods, healthy grocery retail, food policy council, and farmers' markets as of 2015 (Essex, Shinkle, & Bridges, 2016).

Purpose of Study

The purpose of this study was to assess the spatial distribution of 130 farmers' markets in Tennessee, and the sociodemographic factors that affect the distribution of these markets. This study also assessed the relationship between food deserts census tracts, the locality of farmers'

markets, and the acceptance of food assistance program benefits by farmers' markets within the state of Tennessee.

Research Aims & Hypotheses

Research Aim #1

Examine the distribution of farmers' markets across census tracts in Tennessee.

Hypothesis #1.1. It was hypothesized that food desert census tracts in Tennessee were more likely to have at least one farmers' market than non-food desert census tracts.

Hypothesis #1.2. It was hypothesized that urban food desert census tracts in Tennessee were more likely to have at least one farmers' market than rural food desert census tracts.

Research Aim #2

Describe the association between area (census tract) socioeconomic status (SES) and farmers market acceptance of USDA food assistance program benefits in Tennessee.

Hypothesis #2.1. Tennessee farmers' markets located in areas (census tracts) with low SES were more likely to accept benefits from USDA food assistance programs in comparison to those farmers' markets located in areas (census tracts) with high SES.

CHAPTER 2

LITERATURE REVIEW

Food deserts have been a principle cause of hunger for many households in the United States (Ploeg, 2010). These areas have been described as places with inadequate access to affordable, healthy foods and have contributed to both social and health disparities (Beaulac et al., 2009). Moreover, food deserts often contribute to food insecurity. Food insecurity is defined as an economic and social condition of limited access to adequate food at household-level (United States Department of Agriculture, 2016b). Indicators of food insecurity include reduced food consumption, disordered eating patterns, reduced food quality, reduced varieties of food, and/or reduced desirability of food (United States Department of Agriculture, 2016b, 2017b, 2017g). To alleviate food insecurity and increase the availability of healthy options, food must be readily accessible and available (Gundersen, 2013).

Theoretical Framework

This dissertation was based on the Model of Community Nutrition Environments, which is grounded in the Social-Ecological Model of Health Behavior (Glanz, Sallis, Saelens, & Frank, 2005; Story, Kaphingst, Robinson-O 'brien, & Glanz, 2008). While some health behavioral models focus on behavioral changes among individuals, the Social-Ecological Model of Health Behavior has guided research and intervention efforts related to individual factors, social and environment influences, and policies that seek to improve health outcomes, as noted in Figure 1 (Sallis, Owen, & Fisher, 2008; Story et al., 2008). Ecologic approaches to behavior change are

necessary for population-level behavior and organization changes (Glanz & Bishop, 2010; Glanz & Yaroch, 2004; Sallis et al., 2008).

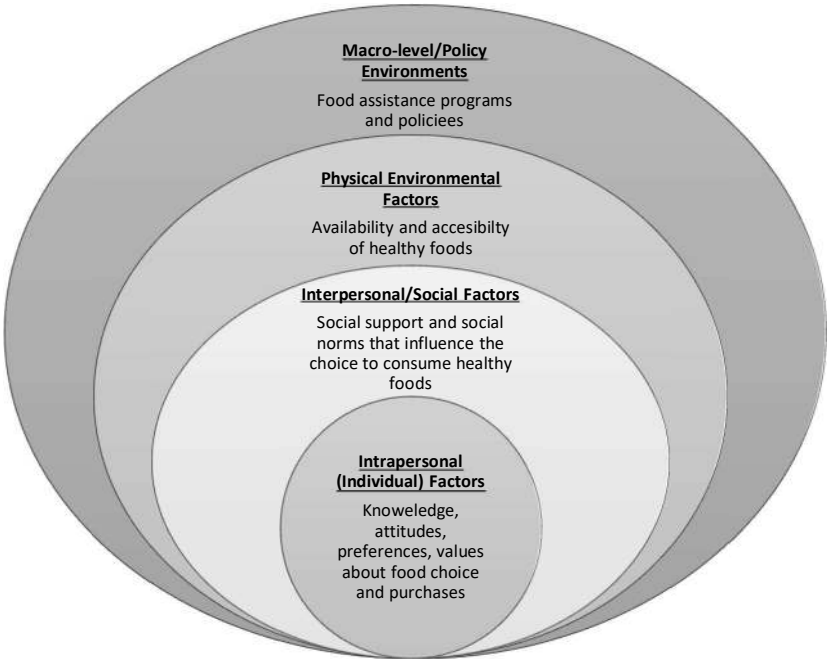

Figure 1: *The Social-Ecological Model of Health Behavior Based on the Ecological Model of Health Promotion*

The Social-Ecological Model of Health Behavior highlights both the environmental and policy-level factors that influence health behavior, which was useful for this study (Sallis et al., 2008). This model includes four core principles: (1) there are multiple influences on health behaviors are various levels; (2) these multiple influences interact across levels; (3) multi-level interventions are most effective in behavior changes; and (4) ecological models are most relevant when specific behaviors are addressed (Sallis et al., 2008).

The intrapersonal-level of this model is associated with an individual's food choices and eating behaviors, and includes perceptions, behaviors, biological, and demographic factors. These factors determine an individual's motivations to purchase and consume healthy options, and to maintain a healthy diet (Glanz & Yaroch, 2004; Kamphuis et al., 2006; Sallis et al., 2008;

Story et al., 2008). At the interpersonal-level of this model, a person's social support system/social network directly influences his or her decision to make the best choices to maintain a healthy diet. This level includes an individual's exchanges with family, peers, and others within the community and impacts that individual's health behaviors through social norms (Kamphuis et al., 2006; Sallis et al., 2008; Story et al., 2008). The physical environment of this level includes settings where people can consume or purchase foods. These locations include schools, restaurants, grocery stores, supermarkets, convenience stores, and farmers' markets (Kamphuis et al., 2006; Sallis et al., 2008; Story et al., 2008). The last level of this model is known as the macro-level. Within this level, factors for behavior change operate within the larger society to include food distribution, pricing, and multilevel policies (Kamphuis et al., 2006; Sallis et al., 2008; Story et al., 2008). An example of a macro-level influence is the Agriculture Adjustment Act (AAA), also known as the Farm Bill. The Farm Bill is a multi-year bill, renewed about every five years, that oversees a collection of agricultural and food programs, such as the USDA's Supplemental Nutrition Assistance Program (SNAP), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and Nutrition Programs for Seniors (Johnson & Monke, 2017).

Based on the Social-Ecological Model of Health Behavior, the Model of Community Nutrition Environments describes several pathways that influence the purchase of healthy options within a community setting (Glanz et al., 2005). This model, depicted in Figure 2, identifies four types of nutrition environments that influence health behaviors: (1) community nutrition environment, (2) organization nutrition environment, (3) consumer nutrition environment, and (4) information environment. Variables in the community nutrition environment include the accessibility (e.g., location within urban and rural areas) and availability

of food outlets (e.g., grocery stores, supermarkets, farmers' markets, etc.). The organization nutrition environment entails where individuals can obtain food, which include the home, school, work and other locations such as churches and healthcare facilities. The consumer nutrition environment reveals what consumers encounter within and around a food outlet, and most of these characteristics also apply to food sources in organization nutrition environments. This environment also includes the presence of nutritional information for healthy options within food outlets. The information environment entails media reports and advertising used for the promotion of government food assistance program benefits at farmers' markets, which can impact attitudes and the appeal of certain foods and food sources. These environments are governed by governmental policies that ultimately influence the perceived nutrition environment and health behaviors.

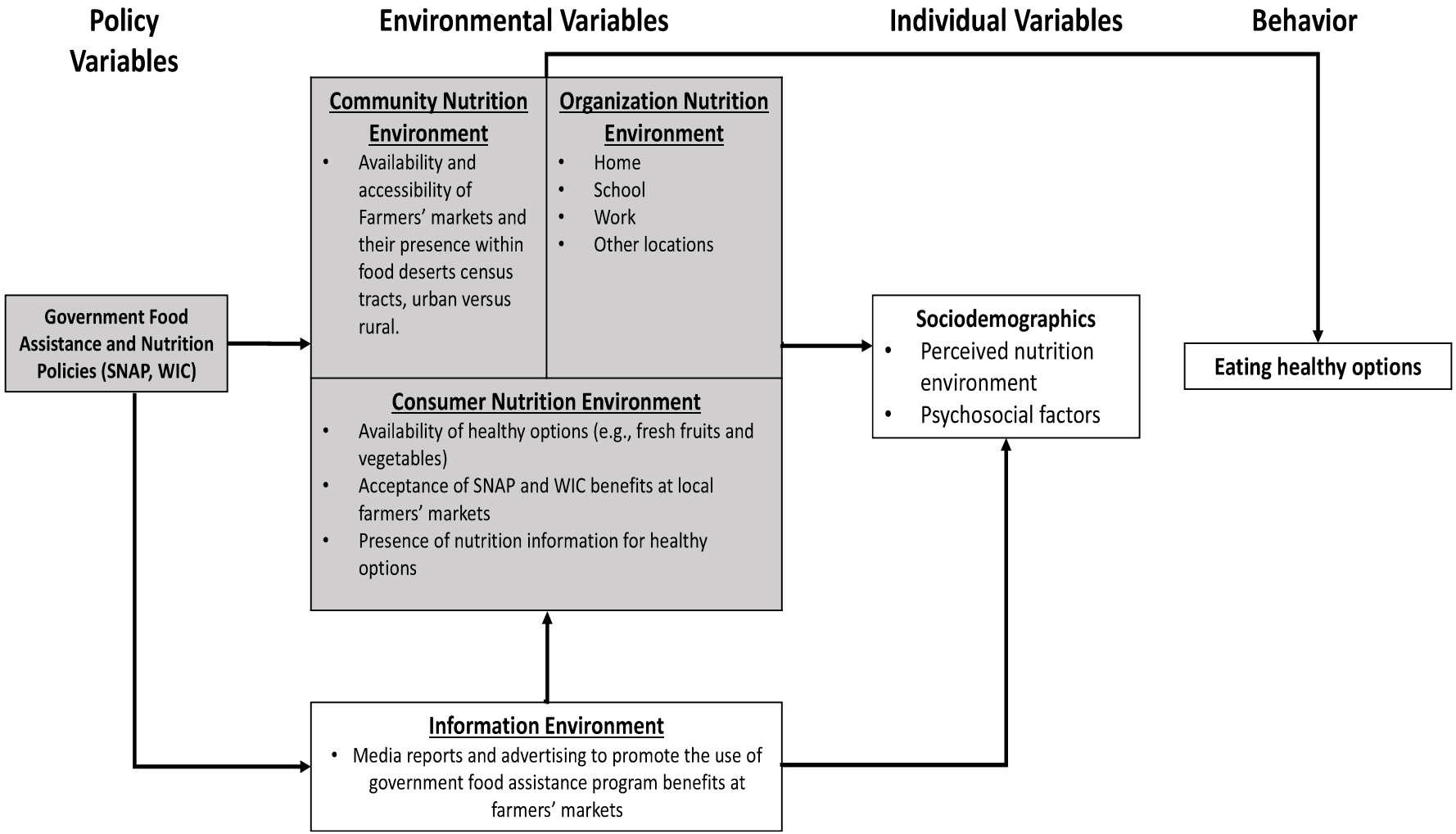

Figure 2: *Study Theoretical Framework Based on the Model of Community Nutrition Environments*

This dissertation has focused on the acceptance of food assistance program benefits at farmers' markets. Within the community and consumer nutrition environments, farmers' markets are present in locations where access to grocery stores and healthy options are limited. Also, the availability of benefits from government food assistance programs (e.g., SNAP, WIC, SFMNP) among low-income, low access consumers increases access to healthy options. Food assistance programs are governed by federal policies that attempt to increase the accessibility and availability of healthy options at the community level. This study has explored the association between the locations of farmers' markets, participation in food assistance programs, and food desert status by census track within the state of Tennessee.

The Source of the Problem

Across the United States, segments of the population continue to struggle with food insecurity, which is particularly concentrated in food deserts areas (Ploeg et al., 2009). Food insecure households have poorer nutrition, which leads to insufficiencies in important nutrients, poorer overall health, increased risks for cardiovascular diseases, poor health management, and increased doctors' visits (Cook et al., 2013; Gundersen et al., 2011; Seligman et al., 2010). As of 2016, 42.2 million Americans (13.2%) were food insecure (12.2% in 2002), which encompassed 29.1 million adults (9.1%) and 13.1 (4.1%) million children (Coleman-Jensen, Rabbitt, Gregory, & Singha, 2016). Additionally, 13.0% of households in the United States (15.8 million) were food insecure; and 17.0% of these were households with children, which had a higher food insecurity rate than those households without children (11.0%) (Coleman-Jensen et al., 2016). Twelve states had significantly higher household food insecurity rates than the 2015 United

States national average (13.4%) (Feeding America, 2017a). Tennessee was ranked No. 12 on this list, with a 15.1% household food-insecurity rate (Feeding America, 2017b).

Food insecurity is distinguished by three components: availability, access, and use (Franklin et al., 2012; Ivers & Cullen, 2011). 'Use' refers to the amount and types of foods consumed, as well as proper food preparation based on the knowledge of basic nutrition (Hodgson, 2012; Ivers & Cullen, 2011). 'Availability' refers to the adequate amount of food available on a consistent basis, while 'access' refers to having adequate resources to obtain healthy food for a balanced, nutritious diet (Ivers & Cullen, 2011). For example, Treuhaft and Karpyn (2013) found that those who do not have a major supermarket or grocery store within one mile of their residence were 25.0 to 46.0% less likely to have a healthy diet in contrast to those with better access to healthy foods.

Health Factors Related to Food Access

Research has shown that there are positive associations between the availability of healthy foods, the increased consumption of healthy foods, and improved nutrition (Bower, Thorpe, Rohde, & Gaskin, 2014; Hodgson, 2012). However, the availability and accessibility of healthy foods are often dependent on certain factors, such as socioeconomic status (SES). For instance, studies have shown that areas with low SES have fewer food outlets containing quality, healthy foods. However, these areas have a surplus of food outlets that sell low quality, unhealthy foods (Bower et al., 2014; Morland et al., 2017). Thus, those without access to healthy foods also have higher obesity and cardiovascular disease rates (Franklin et al., 2012; Gundersen, 2013; Jilcott et al., 2011).

Disparities in Food Access

Food access is a significant cause of food insecurity. Specifically, research has found that the lack of adequate healthy food retail has created food access disparities for low-income and minority communities (Walker, Keane, & Burke, 2010). According to Baker et al. (2006), income and race play a major role in the number and proximity to food outlets within a community. Both are also associated with the location of grocery stores or supermarkets and food selection. Additionally, this study found that multi-racial neighborhoods with high poverty rates and majority African American communities were less likely to have adequate access to grocery stores or supermarkets than majority white, higher-income communities (Baker et al.). Specifically, African Americans communities were four times less likely to have grocery stores or supermarkets than white communities (Galvez et al., 2017). When grocery stores or supermarkets were present within communities, healthier options were more likely to be purchased (Policy Link, 2001). Without access to food retail outlets, these areas are known as "food deserts".

Food Deserts: Urban Versus Rural

Indicators used to determine what characterizes a food desert include: (1) a significant share of a census tract's population who are low-income; (2) average distance (1.0 mile for urban areas or 10 miles for rural areas) in which a household is located from a major supermarket or grocery store with in the census tract; and (3) a tract's poverty rate greater than 20% (Ploeg, 2010). Access to healthy foods for low-income individuals can be problematic in both urban and rural food deserts. For example, food retail sources in urban food deserts are often limited, leaving convenience stores or fast food restaurants as the only source of foods for many (Laska,

Borradaile, Tester, Foster, & Gittelsohn, 2017). More than often, convenience stores and fast food restaurants lack the nutritious selections that are found in grocery stores and supermarkets. However, rural and urban food deserts have differing challenges when accessing healthy foods. Within rural food deserts, populations are smaller, and grocery stores or supermarkets are scarcer. This causes longer travel distances to get to such food retail outlets (Public Health Law Center, 2012).

In addition to travel distances, individuals in both rural and urban food deserts have transportation challenges when accessing foods. Rural residents without reliable transportation often have to depend on others to take them shopping, and urban residents often have to rely on public transportation, taxis, or walk to the nearest food outlet (Vallianatos, Shaffer, & Gottlieb, 2002). Specifically, a study found that low-income households were about seven times more likely to not own a vehicle than other United States households (Vallianatos et al., 2002). Lack of accessibility to healthy options for low-income residents increases the risk for chronic diseases and improper diets (Azétsop & Joy, 2013).

Food Deserts and Farmers' Markets as a Proposed Solution

Access to healthy, affordable foods is essential to ameliorate food insecurity experienced in food deserts. Therefore, researchers, policy makers, and community advocates have been working to find solutions to the problem of food deserts, and reduce the severity of their impact (Hodgson, 2012; Lee & Lim, 2009; Story et al., 2008). These efforts can be characterized into two strategies: (1) increasing access to healthy foods via farmers' markets and (2) providing nutritional assistance by utilizing food assistance programs.

Increasing Access to Healthy Foods via Farmers' Markets

One of the primary reasons behind the disparities among food deserts and other areas is the difference in the average and median household income. Currently, food deserts are defined in terms of both income and distance from major supermarkets or grocery stores. A food access study completed in 2007 found that most supermarkets and grocery stores tend to be located in suburban areas, and a majority of individuals who have a lower income live in urban and rural areas (Anderson, 2007). This study also found that supermarkets and grocery stores located in urban and rural areas had higher operating costs, which were passed on to the consumers compared to suburban stores (Anderson, 2007). This created an accessibility issue for low-income individuals, thus demonstrating the need for farmers' markets. Farmers' markets are considered a reliable source for fresh produce, and can address price disparities experienced by low-income communities. Among farmers' markets, vendors promote and sell their own goods directly to consumers. Unfortunately, farmers' markets are not usually permanent community establishments, sometimes have seasonal schedules, and differ in size and population served (Becker, 2006).

Research has found that 60.0% of farmers' markets shoppers who live in low-income communities believed that farmers' markets had better prices than supermarkets and grocery stores (Project for Public Spaces, 2013). To support this claim, "several studies have reported that prices at farmers' markets are lower (by 10.0 to 28.0%) than those at nearby grocery stores because of cost savings to farmers from selling directly to consumers" (Young et al., 2011, p. 78). Young et al. (2011) also found that about one-third of low-income residents shop within one mile of their home. This is troubling for those areas that lack a major grocery store or

supermarket. These factors illustrate the need and value of farmers' markets to low-income, low-access communities.

Over the past twenty years, the number of farmers' markets has doubled from 4,385 in 2006 to 8,674 in 2017 according to the 2017 USDA Farmers Market Directory (United States Department of Agriculture, 2017c). This growth is largely in part because farmers' markets connect consumers with where and how their food is grown, create new economic opportunities for producers, and help increase healthy food access in rural and urban communities across the country (United States Department of Agriculture, 2017a).

Farmers' markets also provide fresh fruits and vegetables to communities lacking them and serve as sites providing fresh produce for residents, including those who receive food assistance benefits through federally funded programs. This increases the opportunity of low-income residents to purchase healthier options (Mccracken et al., 2012). However, farmers' markets face many challenges when trying to succeed in low-income communities. These challenges include operating on small budgets, lack of administrative staff and volunteers, lack of sufficient marketing and advertising funds, and limited number of farmers' markets located within food deserts that offer food assistance programs for residents in need (Ahn et al., 2014).

Providing Nutritional Assistance by Using Government Programs

While increasing food access is important, it has been shown that the introduction of new farmers' markets does not necessarily lead to healthier eating behaviors and better health outcomes (Cummins, Flint, & Matthews, 2014). In such cases, it may be helpful to also provide

nutritional assistance to assist low-income community members with the purchasing of better choices regarding their food selection through government food assistance programs.

Low-income communities are considered areas for significant improvement for nutritional access, and USDA has designed federal food assistance programs just for that purpose. The USDA's goal is to decrease food insecurity and hunger by increasing access to healthy food and providing nutritional education to those who are low-income (Committee on Examination of the Adequacy of Food Resources and SNAP Allotments; Food and Nutrition Board; Committee on National Statistics; Institute of Medicine; National Research Council, 2013). Some of the nutrition assistance programs offered by USDA include the National School Lunch and School Breakfast (School Meals) Programs, including summer food service; the Child and Adult Care Food Program (CACFP); the Food Assistance for Disaster Relief; the Emergency Food Assistance Program; the Food Distribution Program on Indian Reservations; the Supplemental Nutrition Assistance Program (SNAP); and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), which included the Farmers Market Nutrition Program(FMNP) and the Senior Farmers' Market Nutrition Program (SFMNP) (Oliveira, 2016). This study focused on the Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the Senior Farmers' Market Nutrition Program (SFMNP).

USDA Food Assistance Programs

Expenditure for USDA's national food and nutrition programs totaled to $104.1 billion in fiscal year (FY) 2015, which was about 5% lower than the historical high of $109.2 billion set in FY 2013 (Oliveira, 2016).

The Supplemental Nutrition Assistance Program (SNAP)

The main and largest food assistance program is the Supplemental Nutrition Assistance Program (SNAP), formally known as the Food Stamp Program (FSP), founded in 1939 in response to the Great Depression (Committee on Examination of the Adequacy of Food Resources and SNAP Allotments; Food and Nutrition Board; Committee on National Statistics; Institute of Medicine; National Research Council, 2013). During this time, the United States was experiencing economic downfall, high unemployment rates, and a surplus of unpurchased foods (United States Department of Agriculture, 2017f). Fortunately, individuals could purchase food stamps at discounted price, which would be equal to the funds normally spent on food thanks to the FSP. Stamps were color-coded orange and blue, and for every $1 orange stamp purchased $0.50 worth of blue stamps were given. Orange stamps were used to buy any type of foods; however, the blue stamps were only to be used to buy USDA-determined surplus foods (United States Department of Agriculture, 2017f). This program ended four years after its implementation; however, on February 2, 1961, President John F. Kennedy re-instated the Food Stamp Program and expanded food distribution through executive order (Committee on Examination of the Adequacy of Food Resources and SNAP Allotments; Food and Nutrition Board; Committee on National Statistics; Institute of Medicine; National Research Council, 2013). Congress then passed legislation to make this executive order permanent in 1964 (Committee on Examination of the Adequacy of Food Resources and SNAP Allotments; Food and Nutrition Board; Committee on National Statistics; Institute of Medicine; National Research Council, 2013). After a series of checks and balances, the Food Stamp Act of 1977 eliminated purchase requirements and established income eligibility guidelines at the federal poverty level (Committee on Examination of the Adequacy of Food Resources and SNAP Allotments; Food

and Nutrition Board; Committee on National Statistics; Institute of Medicine; National Research Council, 2013). The Food Stamp Program (FSP/SNAP) has greatly improved over the last thirty years through income modifications, streamlined processes, the creation of penalties for fraud, and the endorsements of nutrition education programs and grants. Until the implementation of the Personal Responsibility and Work Opportunity Reconciliation Act of 1996, food stamps were issued as paper coupons. This act required all States to distribute food stamp benefits via Electronic Benefits Transfer card (EBT). EBT is an electronic system that authorizes the transfer of government benefits from a Federal account to a retailers' account to pay for products (Committee on Examination of the Adequacy of Food Resources and SNAP Allotments; Food and Nutrition Board; Committee on National Statistics; Institute of Medicine; National Research Council, 2013).

Today, the SNAP Program provides nutritional assistance to children and families, the elderly, the disabled, unemployed and working families. This program accounted for approximately 71.0% of all federal food and nutrition programs in 2015 (Oliveira, 2016). Also, of the 320.9 million U.S. residents, approximately 45.8 million people (14.3%) participated in the program per month that same year. Federal spending for SNAP totaled approximately $73.9 billion during FY 2015 (Oliveira, 2016). In Tennessee, SNAP provided about $1.88 billion dollars to approximately 1.2 million people in FY 2015 (Food and Nutrition Service, 2017a).

This program supplements food budgets of families with low income and allows them to direct more of their available income toward critical living expenses (United States Department of Agriculture, 2017f). Farmers' markets can now accept SNAP benefits using a point-of-sale

(POS) EBT device or they can fill out a paper voucher to redeem SNAP benefits in exchange for tokens or receipts (United States Department of Agriculture, 2017f).

Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

The purpose of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is to protect and improve the health of low-income women, infants, and children up to age five who are at nutritional risk (Oliveira, Racine, Olmsted, & Ghelfi, 2002). This program provides grants for supplemental foods, nutritional services, and screenings and referrals to health care and social services. The WIC Program accounted for approximately 6.2% of all federal food and nutrition programs in 2015 (Oliveira, 2016). Also, an average of 8 million people participated in the program per month that same year, with children making up 52.0% (women: 24.0%; infants 24%) of all participants (Oliveira, 2016). Program expenditure totaled approximately $6.2 billion during FY 2015 (Oliveira, 2016). In Tennessee, WIC provided about $38.0 million to approximately 150,000 people in FY 2015 (Food and Nutrition Service, 2017b, 2017c).

The origins of the WIC program date back to the 1960s when the United States recognized that many low-income individuals were suffering from malnourishment (Oliveira et al., 2002). In response to this issue, specifically among low-income mothers and children, the USDA created the Commodity Supplement Food Program in 1969. This program provided commodities to feed low-income mothers, infants, and children up to the age of 6 (Oliveira et al., 2002). On September 26, 1972, this program was formally authorized as the WIC Program by the Child Nutrition Act of 1966 as a two-year pilot program. During that time WIC was operating in 45 states. Because of its success, WIC was established as a permanent program on October 7, 1975 (Oliveira et al.,

2002). Three years later, the Child Nutrition Amendments of 1978 established income standards for program eligibility, which entailed a household's income not exceeding 195% of the federal poverty level. This Act also strengthened the program's nutrition education component by requiring all participants to receive nutrition education from funded agencies. To add to the success of WIC and address limited access to healthy options, the Hunger Prevention Action of 1988 provided grants to 10 states to implement the Farmers' Market Demonstration Project. This Project rewarded these states with 3-year grants, which provided WIC participants with coupons that could be used for the purchasing of fresh fruits and vegetables (United States Department of Agriculture, 2016c). The success of this project led to the enactment of WIC Farmers' Markets Nutrition Act of 1992, which established the WIC Farmers' Market Nutrition Program (FMNP).

The Farmers' Market Nutrition Program (FMNP)

The objective of this program was to provide fresh fruits, vegetables, and herbs to those (women, infants over four months, and children) who were WIC participants or waitlisted, and to increase the awareness of farmers' markets (Oliveira et al., 2002; United States Department of Agriculture, 2016c). The FMNP is currently managed through federal and state collaborations in which the Food and Nutrition Service (FNS) affords cash grants to state agencies (United States Department of Agriculture, 2016c). Eligible WIC participants are issued FMNP vouchers in addition to regular WIC benefits. These vouchers can then be used at farmers' markets that have been approved by the state agency to accept FMNP vouchers. The farmers or farmers' market managers then submit the redeemed FMNP vouchers to the bank or state agency for reimbursement (United States Department of Agriculture, 2016c).

In FY 2015, 1.7 million WIC participants received FMNP benefits from an allocation of $19.6 million in granted funds in the United States (Food and Nutrition Service, 2016). Tennessee received $79,575 of these funds, which benefited 8,403 WIC participants (Food and Nutrition Service, 2017b). During this time, 7,926 farmers (Tennessee: 91), 3,390 farmers' markets (Tennessee: 21) and 2,894 roadside stands (Tennessee: 7) were authorized to accept FMNP vouchers in the United States (Food and Nutrition Service, 2016).

The Senior Farmers' Market Nutrition Program (SFMNP)

Less than one-third of senior citizens in the United States consume the suggested quantity of fruits and vegetables, which are vital to avoiding and treating health issues (National Sustainable Agriculture Coalition, 2016). Established in 2001 as a USDA pilot program, the Senior Farmers' Market Nutrition Program (SFMNP) was designed to improve the diets of low-income seniors. However, it was not until 2002 that the Farm Bill permanently authorized the program and allocated $15 million per year for implementation and expansion (National Sustainable Agriculture Coalition, 2016). The 2014 Farm Bill provided $19.199 million to operate in FY 2015 (United States Department of Agriculture, 2015b).

The awards currently grants 52 state agencies, U.S. territories, and federally recognized Indian tribal governments to provide low-income seniors aged 65 and over with vouchers that can be exchanged for eligible foods (fruits, vegetables, honey, and fresh-cut herbs) at farmers' markets, roadside stands, and community-supported agriculture programs (United States Department of Agriculture, 2015b). The farmers or farmers' market managers then submit vouchers to a bank or state agency for reimbursement (United States Department of Agriculture, 2016c).

Farmers' Markets and USDA Food Assistance Programs in Food Deserts

As a criterion to receiving federal funds for SNAP and WIC (FMNP and SFMNP) benefits, each applying or participating agency must submit an annual State Plan describing how the agency intends to implement, operate and administer all aspects of these programs within its jurisdictions (United States Department of Agriculture, 2015b, 2016c, 2017f). Within these State Plans, farmers' markets must become certified to accept food assistance program benefits. Currently, of the 8,674 farmers' markets in the United States, 53.6% of the markets (Tennessee: less than 1.0%) have yet to become certified to participate in any USDA food assistance program (United States Department of Agriculture, 2017c). This may be due to the insufficient resources such as management, staff, time, materials, and knowledge required for implementation and sustainability (Mccracken et al., 2012; Prince George's County Health Department-Healthy Eating Active Living (PGHEAL), 2014). These insufficient resources may present challenges for farmers' markets and food assistance recipients (Prince George's County Health Department-Healthy Eating Active Living (PGHEAL), 2014).

The outcomes of food assistance programs vary by state. For example, larger states have the access and capability to apply the resources needed to implement food assistance programs at their local farmers' markets in comparison to smaller states (United States Department of Agriculture, 2016c). In 2010, researchers at Vanderbilt University used U.S. Census Data to show the geographic distribution of food deserts and their impact across Tennessee, in which over 20.0% of residents lived in food deserts (Rural Health Association of Tennessee, 2010). Within these food deserts, only 61.0% of Tennessee census tracts had at least one healthy food retailer within one-half mile of the tract boundary (Prevention Research Center (PRC), 2016).

Additionally, 46.0% of Tennessee residents reported consuming fruit less than one time per day, and 25.0% reported consuming vegetables less than one time per day (McGuire, 2013).

Potential Solutions to Food Deserts in Tennessee

Ameliorating food deserts has become a priority for national-level food and nutrition policies (Jiao et al., 2012; Mccracken et al., 2012). Specifically, the Prevention Research Center in St. Louis, in partnership with the Tennessee Obesity Taskforce, conducted a rapid Health Impact Assessment (HIA) for the Tennessee Food Desert Relief Act (SB 1176). The HIA was completed prior to senate vote and recommended a series of changes and specifications.

Potential Impacts of the Tennessee Food Desert Relief Act (SB 1176)

Of the 6.5 million people who live in Tennessee, an estimated 1.5 million (23.1%) live in rural areas (United States Department of Agriculture, 2017e) . Those living in rural areas, where many food deserts exist, often experience more adverse health and economic impacts than those living in urban areas (Larson et al., 2009). However, due to the lack of specificity concerning the kinds and amounts of foods sold in farmers' markets, it is not known what impact the bill could have on obesity and related cardiovascular diseases (Prevention Research Center (PRC), 2016). However, it is speculated food desert residents would have increased access to fruits and vegetables through the allocation of funds for the establishment and support of farmers' markets (Prevention Research Center (PRC), 2016).

The Tennessee Food Desert Relief Act was introduced during the 2012 legislative session, and would have authorized the use of revenue bonds and loans to develop property into food desert relief enterprises (FDRE). The HIA focused on how the bill would affect rural and

urban residents by improving access to healthy, affordable foods (Prevention Research Center (PRC), 2016). The HIA found that overall the bill had potential to improve health in Tennessee, yet needed to be amended to take full advantage of the health benefits. The HIA also endorsed defining food deserts, FDREs, and healthy foods to help explain the various initiatives that qualified for subsidies under the bill. The HIA also endorsed that FDRE applications be scored according to health-promoting benchmarks, such as whether the recommended locations were near public transportation routes, and included prioritizing spaces and populations with the most burdens related to food access (Prevention Research Center (PRC), 2016). While the recommendations were important, the bill failed to pass Senate vote; and further actions were not taken.

Other National and Tennessee-Specific Healthy Food Access Policy Efforts

A national initiative proposed by government agencies to address food deserts, known as the Healthy Food Financing Initiative (HFFI), was proposed by President Barack Obama's administration in 2010. HFFI provides subsidies to bring healthy food retailers such as farmers' markets to low-income communities in urban and rural areas in order to increase access (United States Department of Treasury, 2010). Since 2011, HFFI has distributed more than $140 million to more than seventy community development financial institution (CDFIs) and community development corporations (CDCs) throughout the United States to provide grants and loans to regional projects (The Food Trust, 2016). In addition to federal initiatives, states and local communities have been working to address the issue of food deserts.

Funded by the Robert Wood Johnson Foundation and published by the Food Trust, a report highlighted the lack of access to healthy food in low-income communities in Tennessee

(Taylor, Tucker, & Harries, 2012). This report led to a convening of key stakeholders in Tennessee by the American Heart Association, the Tennessee Grocers and Convenience Association, the Food Trust and other public health and supermarket industry leaders. This convening, known as the Tennessee Grocery Access Taskforce, developed a series of policy recommendations to increase access to healthy, affordable foods for Tennessee residents who lived in underserved areas. These recommendations included: (1) encouraging both state and local governments to work with local organizations and merchants to develop affordable and efficient transportation for communities who lack access to supermarkets; (2) encouraging state and local governments to partner with local grocers, organizations and public health professionals to support best practices for disseminating healthy foods through HFFI; (3) implementing HFFI programs to encourage affordable, healthy and fresh food options in underserved low-income neighborhoods; and (4) encouraging state and local governments to develop a comprehensive food access methodology focused on supermarket access (Taylor et al., 2012). In response to the Taskforce's recommendations, there have been both state and local HFFI initiatives implemented in areas of need.

One of these programs, known as the Mid-South Healthy Food Initiative, is administered by the Hope Enterprise Corporation in partnership with the Food Trust. This initiative is a regional HFFI program that offers flexible financing for new store pre-development, development, and initial operations costs, as well as training with retailers to promote healthier choices projects across Tennessee and two other states. HOPE has provided over $42 million for 61 HFFI projects, which have developed more than 179,00 square feet of additional grocery store space in low-income and low-access neighborhoods since 2011 (Healthy Food Access Portal, 2017)

Additionally, the AARP Foundation implemented the Fresh Savings Program in partnership with the Wholesome Wave Foundation in 2011. The Fresh Savings Program is a SNAP incentive and nutrition education program promoting the use of benefits across certified farmers' markets in Tennessee. This program encourages SNAP consumers to purchase more fruits and vegetables with their SNAP benefits by offering matching incentives. For example, beneficiaries who spend up to $20.00 on fresh fruits and vegetables with their SNAP card at participating farmers' markets receive up to an additional $20.00 more to spend on fresh fruits and vegetables for free (AARP Foundation, 2017).

Another organization, The Works, Inc., used HFFI to support the growth of a Memphis-based farmers' market to include a year-round greengrocer in 2014. The project turned a vacant 3,600-square-foot former gas station into a small grocery store with a permanent outdoor facility for the South Memphis Farmers' Market. An education and demonstration kitchen also was included to host cooking and nutrition classes. This expansion created 40 new, full-time, livable wage jobs with career potential for low-income residents ("The Works, Inc.," 2016).

HFFI has been proven to be an economically sustainable solution addressing the lack of fresh food access in low-income, low access communities (food deserts). Specifically, throughout Tennessee, HFFI has contributed to the establishment of public-private partnerships to revitalize distressed communities by supporting the development or renovation of healthy food retail projects, such as grocery stores, convenience stores, food hubs, and farmers' markets. The aforementioned Tennessee-specific policies and initiatives have contributed to the development of the local workforce, generated local and state revenues, and increased access to healthy foods for children and families.

Farmers' Markets and Spatial Inequalities within Food Deserts

Many intervention studies, including the aforementioned policies and initiatives, that have focused on behavior of individuals did not result in long-term nutritional changes; however, research has begun to focus more on food deserts through examination of "spatial inequalities" in access to healthy foods and food assistance using geographic information system (GIS) analysis (Cummins & Macintyre, 2006; Waity, 2016).

'Spatial inequality' is an important dimension of access to healthy food assistance, and can be defined as the unequal distribution of goods, resources, or services within a geographical area (Waity, 2016). This is particularly useful when comparing rural and urban areas. Over the years, the United States has become more urban, with over 80.0% of the population (77.4% in Tennessee) living in urban areas (United States Census Bureau, 2016; United States Department of Agriculture, 2017e). Despite a decreasing rural population, those living in rural areas have distinct challenges in comparison to those living in urban areas. For instance, Waity (2016) gathered the population demographic and socioeconomic data from 24 counties in Indiana in which food pantries and soup kitchens were located, and mapped the location of these agencies using geographic information system(GIS) analysis. This study used GIS to assess how spatial inequality impacted food security, specifically focusing on the location of food assistance agencies and low-income areas throughout Indiana (Waity, 2016). Using the population center of the census tracts, this study measured the distance from the population center, usually the county seats, to the nearest food assistance agency. If the closest agency was more than a mile away, the census tract was considered a food assistance desert, a concept drawn from on the USDA's food desert measurement. This study found that rural high-poverty counties in the sample were more

likely to contain census tracts that were food assistance deserts, and urban high-poverty counties were least likely to contain food assistance deserts (Waity, 2016). Waity (2016) also found that rural areas were more likely to have greater poverty rates and have lower per-capita income than urban residents in Indiana. These findings were consistent with Tennessee 2015 data, in which the rural poverty rate was 19.5% (urban poverty rate: 15.9%); and rural per-capita income was $32,232 (urban per-capita income: $44,694) (United States Department of Agriculture, 2017e). Rural-to-urban differences regarding food insecurity still exist today.

McCracken, Sage & Sage (2012) examined the degree to which farmers' markets increased access to low-income consumers by accepting vouchers from the WIC Program and SFMNP in the state of Washington. This study also explored the effects of distance on lower-income residents' ability and willingness to access local produce at farmers' markets. At the time of this study, Washington had 1,004 census tracts and 64 of those tracks were identified as urban food desert census tracts and 17 were identified as rural food desert census tracts (McCracken et al., 2012). This study utilized GIS spatial and regression analyses, and found a negative relationship between the average distance individuals traveled to reach a farmers' market, and the rate at which WIC vouchers were redeemed. This meant that food assistance recipients who did not live close to a farmers' market were less likely to engage markets to use their benefits (McCracken et al., 2012).

Another study was conducted in Arizona to determine the proximity of food deserts to farmers markets in state using GIS mapping (Yanamandra, 2015). To determine the locations of food deserts in Arizona, this research used data from the USDA's Food Desert Research Atlas (i.e. Food Access Research Atlas). This data source included information from the most recent

census conducted and information regarding population income, grocery store access, and urban/rural classification for each tract. Next, this study determined the location of each farmers' market throughout the state by using USDA Agricultural Statistics (i.e. the USDA Farmers Market Directory) (Yanamandra, 2015). To show the distribution and proximity of farmers' markets with food deserts, this study used ArcGIS to create geographical maps that identified the locations of resources. There were 236 food deserts in the Arizona, of which 56 were in rural areas and 180 were in urban areas. This study mapped 47 farmers' markets, of which 17 (36.0%) were within a 1-mile radius of a food desert. Yanamandra et al. (2015) also determined that farmers' markets who accepted food assistance benefits were less accessible to those who lived within 1-mile of a food desert. Lastly, only 4 (23.5%) of the 17 markets accepted any type of food assistance benefit (Yanamandra, 2015).

A study by Anderson and Burau (2015) investigated the association between 200 farmers' markets and food insecurity in the state of Texas using the USDA's Food Desert Research Atlas (Food Access Research Atlas), United States Census data, and Texas farmers' markets data. Specifically, data collected included age, sex, race, income, and grocery store access by census tract, and a listing of farmers' markets. This study followed USDA's protocol, and labeled a census tract as low-access if 500 or more of its residents or 33.0% of its population lived more than one mile (for urban areas) from a grocery store or 10 miles (for rural areas). These data were then analyzed using logistic regression and spatially investigated using GIS. Consistent with previous literature, this study found that farmers' markets were clustered in areas with higher population density (i.e. urban areas) like Houston, Austin and Dallas (Anderson & Burau, 2015). Also, this study found that gender, race, and distance to nearest farmers' markets were associated with food insecurity (Anderson & Burau, 2015). Specifically, this study found

that being a woman and African American increased a resident's odd of being food insecure. This study also found that living in an urban census tract increased the odds of being in a food desert, and each additional mile in distance from a farmers' market increased the odds of being in a food desert.

A similar study was completed for the state of Georgia. This study analyzed the relationship between food desert census tracts, access to food assistance programs at farmers' markets, and location of farmers' markets utilizing descriptive statistics and spatial visualizations (Brace et al., 2016). It also used data from the USDA's Farmers' Market Directory and Food Desert Research Atlas. Addresses of farmers' markets were geocoded in GIS and the data from the Food Desert Research Atlas was analyzed using descriptive statistics. Spatial visualizations were used to analyze the relationship between locations of farmers' markets, participation in food assistance programs, and food desert status by census tract in Georgia (Brace et al., 2016). This study found that Georgia farmers' markets (n=138) tended to cluster within major metropolitan (urban) areas. Of these markets, 77.7% of them did not participate in any food assistance programs, and there were not any spatial patterns of farmers' markets by their food assistance program status (Brace et al., 2016).

Conclusion

The strong association between healthy food access and health outcomes drives the need for supplementary research on healthy food accessibility at farmers' markets and the presence of food assistance programs within food deserts. Without geographic access to food assistance agencies or those food retail outlets that accept such benefits, individuals who experience food insecurity may not be able to maintain a nutritious diet. From a public health perspective, spatial

visualizations of farmers' markets, participation in food assistance programs, and food deserts could be used by public health professionals to determine what resources available are needed among those who live in food deserts. This study assessed the relationship between the presence of farmers' markets, the markets participation in USDA food assistance programs (SNAP and WIC), and food desert status among Tennessee census tracts.

CHAPTER 3

METHODOLOGY

Study Area

Tennessee covers a geographic area of 41,234 square miles, which is divided into 95 counties and 10 metropolitan areas. According to the 2011-2015 American Community Survey 5-Year Estimates, approximately 6,499,615 people lived in Tennessee (United States Census Bureau, 2016). The median household income from 2011-2015 was $47,328 (United States Census Bureau, 2016). Nearly 85.5% of residents over age 25 had at least a high school degree; 24.9% had a bachelor's degree or higher (United States Census Bureau, 2016). Approximately 77.8% of the state's population were Caucasian, 16.8% were Black or African American, and 4.9% were Hispanic or Latino (United States Census Bureau, 2016). Finally, approximately 17.2% of the population lived below the federal poverty level (United States Census Bureau, 2016).

Data Gathering

Data sources for this study included the 2017 USDA Farmers Market Directory and the 2015 USDA Food Access Research Atlas, which included 2010 Census data and 2011-2015 American Community Survey (ACS) data.

2017 USDA Farmers' Market Directory

Since 1994, the USDA has been counting operational farmers markets across the country using the National Farmers Market Directory (United States Department of Agriculture,

2017c). It has accumulated information detailing where farmers' markets operate, what they sell, and how they were managed. It also contained information about markets who were certified to accept benefits from federal food assistance programs (United States Department of Agriculture, 2017c).

At the time of this study, there were 8,674 farmers' market listed in the USDA's Farmers' Market Directory: 2,767 (31.9%) farmers' markets accepted SNAP benefits; 1,300 (15.0%) accepted WIC (FMNP) benefits; and 2,767 (31.9%) farmers' markets accepted SFMNP benefits. Only 746 (8.6%) of these farmers' markets accepted benefits from all food assistance programs. Of all US farmers' markets, 130 were Tennessee area markets (United States Department of Agriculture, 2017c).

Information included in the Farmers' Market Directory has always been completely voluntary and self-reported by market managers, representatives from state farmers market agencies and associations, and other key market personnel. Additionally, the USDA solicits new and current markets to update their information on an annual basis (United States Department of Agriculture, 2017c). However, this has been a flawed method because the directory could be missing information relating to smaller, pop-up farmers' markets who may lack the resources such as volunteers, technology or sustainability to report their data.

Although consumers have used the directory to find farmers markets in their communities, researchers, non-profits, and academics continue to use it to analyze the farmers' market industry. Specifically, the directory has been used to chart farmers' market industry growth, allocate resources, and help develop initiatives dedicated to building stronger local and regional food systems (United States Department of Agriculture, 2017c). It has also been used

by the government when considering policy, system, and environmental (PSE) changes that impact farmers' markets and communities. The media has utilized it when reporting about the progress of farmers' markets (United States Department of Agriculture, 2017c).

2015 USDA Food Access Research Atlas

The 2015 Food Access Research Atlas uses a map of the entire United States to show which census tracts are food deserts based on multiple indicators of food access. These indicators included the accessibility to sources of healthy food; individual-level factors that may affect accessibility, such as family income or vehicle availability; and neighborhood-level factors, such as the average neighborhood income and the availability of public transportation (United States Department of Agriculture, 2017g). The USDA Food Access Research Atlas collects the following data (United States Department of Agriculture, 2017h):

- United States census tract food desert designations,
- 2010 Census population data,
- 2011-2015 American Community Survey (ACS) data.

The 2015 Food Access Research Atlas gives audiences a spatial overview of food access indicators for low-income census tracts using various measures of supermarket accessibility. It also provides food access data for populations within census tracts, and gives data on food access at the census tract level (United States Department of Agriculture, 2017h). This data can be downloaded for community planning or research purposes at no charge. Using this Atlas, a researcher can produce maps displaying food access indicators by census tract using different measures and indicators of supermarket accessibility and compare food access measures based

on 2011-2015 ACS data with the previous 2010 Census measures for selected target populations (United States Department of Agriculture, 2017g).

The linked datasets, 2010 Census and 2011-2015 ACS, used in this Atlas have offered information to categorize residents who have low access to healthy options, live more than 1 mile (urban settings) or 10 miles (rural settings) from a major supermarket or grocery store, and are designated as low-income by the census. Urban-Rural designation and population data, including age and race from the 2010 Census are included at the census tract level within the Atlas (United States Department of Agriculture, 2017g). The Atlas also includes data on sociodemographics, vehicle availability, and SNAP participation from the 2011-2015 American Community Survey (ACS) at the census tract level (United States Department of Agriculture, 2017g).

Data Analysis

Data used for the completion of this study was analyzed using IBM SPSS Statistics Version 21.0. Additionally, ArcGIS 10.0 was used to generate maps for the displaying of the distribution of Tennessee census tracts, food deserts, and the presence of farmers' markets.

Research Aim #1: Examine the distribution of farmers' markets across census tracts in Tennessee.

The researcher hypothesized that food desert census tracts in Tennessee were more likely to have at least one farmers market than non-food desert census tracts. There are currently 1,497 census tracts in Tennessee; however, not all census tracts have a farmers' market present (United States Census Bureau, 2010). A dataset of the Tennessee food deserts, provided by the 2015

USDA Food Access Research Atlas, indicated which of the 1,497 Tennessee census tracts were classified as food deserts. These census tracts were classified as food desert based upon the USDA's definition of a food desert, which is a census tract with low-access to healthy food, where at least 500 people or at least 33.0% of the tract's population live more than one mile from a supermarket or large grocery store in urban census tracts or more than ten miles from a supermarket or large grocery store for rural census tracks (United States Department of Agriculture, 2016b). Data were then exported into SPSS and recoded for analysis.

Specifically, within the new SPSS dataset, if a census tract was identified as a food desert, then the census tract was coded as '1'; and a census tract identified as non-food desert was coded as '0'. Additionally, in terms of urban and rural designations, if a census tract was identified as an urban food desert, then the census tract was coded as '1'; a census tract identified as a rural food desert was coded as '0'.

The researcher also hypothesized that urban food desert census tracts in Tennessee were more likely to have at least one farmers market than rural food desert census tracts. To test this hypothesis, the geographic information (addresses) of Tennessee farmers' markets was provided by the 2017 USDA Farmers' Market Directory. At the time of this study, there were 130 farmers' markets in Tennessee. The address of each farmers' market was matched with the appropriate census tract in the new SPSS spreadsheet using the US Census Bureau's Census Geocoder. This is an address look-up tool that converts any United States address to an approximate coordinate (latitude/longitude) and returns census tract information in which the address is located (United States Census Bureau, 2017). A new variable was then created in the SPSS dataset, which represented the presence of a farmers' market. Census tracts with at least

one farmers' market present were coded 1 for 'Yes', and those census tracts without a farmers' market present were coded 0 for 'No'.

This research aim was evaluated using a chi-square test of independence. This analysis determined if there was a significant difference between frequency of food desert census tracts and non-food desert census tracts with at least one farmers' market present. This analysis also determined if there was a significant difference between the frequency of urban food deserts and rural food deserts with at least one farmers' market present. The presence or absence of farmers' markets was the outcome variable for this analysis, while the food desert identification and type of food desert census track served as the independent variables. Descriptive statistics (frequencies and percentages) were also used to assess how many census tracts were identified as food deserts, and which were identified as urban or rural areas.

Research Aim #2: **Describe the association between area (census tract) socioeconomic status (SES) and farmers market acceptance of USDA food assistance program benefits in Tennessee.**

In addition to food access data, the 2015 Food Access Research Atlas contained 2011-2014 American Community Survey (ACS) demographic and socioeconomic data of each census tract. This included the total population, gender, age, race, ethnicity, income, poverty level, employment status, educational attainment and the number of households receiving government assistance (i.e. SNAP). The presentation of this data was intended to give the reader a broad picture of the demographics of all census tracts, including those with and without at least one farmers' market present, using descriptive statistics (i.e. frequencies and percentages).

The researcher hypothesized that Tennessee farmers' markets located in areas (census tracts) with a low socioeconomic status (SES) were more likely to accept any type of USDA food assistance program benefit. SES has been measured using a variety of indicators including poverty level, income, educational attainment, and employment. However, to assess the census tracts' SES for this research, the Food Access Research Atlas used poverty level and median family income as its indicators. Recall that a census tract was identified as a food desert if the poverty rate for that tract is at least 20%, or for tracts not located within a metropolitan area, the median family income for the tract does not exceed 80% of statewide median family income. Therefore, within the dataset, those census tracts that met these criteria were identified as low-SES tracts or high-SES tracts. Low-SES census tracts were coded as '1' and high-SES tracts were coded as '0'.

Next, the types of food assistance programs' benefits (i.e. SNAP, WIC/FMNP, and SFMNP) accepted by Tennessee farmers' markets were provided by the 2017 USDA Farmers' Market Directory. Of the 130 Tennessee farmers' markets listed in the Directory, 39 currently accepted SNAP benefits, 6 accepted WIC benefits, and 7 accepted SFMNP benefits. These variables (i.e. accepted SNAP, accepted WIC, and accepted SFMNP) were also included in the dataset and coded as 1 for 'Yes' and 0 for 'No'. A new sum variable was then computed to assess how many types of benefits each market accepted. Farmers' markets acceptance of any three of USDA programs' benefits was coded as 1 for 'Yes' and 0 for 'No'.

This research aim was evaluated using a chi-square test of independence. This analysis determined if farmers' markets located in low-SES census tracts were more or less likely to accept any three of the government food assistance program benefits than those farmers' markets

located in high-SES census tracts. This research aim assessed farmers' markets acceptance of at least one of the food assistance program benefits based upon the market's location within a low- or high-SES census track. Markets' acceptance of government food assistance programs' benefits was the outcome (dependent) variable for this analysis, while census track SES (low or high) served as the independent variable.

CHAPTER 4

RESULTS

This chapter describes the results of the statistical analyses as outlined in Chapter 3: Methodology.

Research Aim #1

Description of Data: Tennessee Census Tracts and Farmers' Markets

In Tennessee, there were 1,497 census tracts. As shown in Table 1, of all Tennessee census tracts, 896 (59.9%) were urban (rural: 40.1%); 270 (18.0%) census tracts were designated as food deserts; and, of food desert census tracts, 239 (88.5%) census tracts were designated as urban food deserts (rural food desert: 11.5%). Additionally, only 121 (8.1%) of the 1,497 census tracts had at least one farmers' market present (see Figure 3), which was less in comparison to the 11.8% of all US census tracts (n=72,864) with at least one farmers' market present.

Table 1:

Tennessee Food Deserts Census Tracts, Identification of Urban and Rural Food Deserts Census Tracts, and Presence of Farmers' Markets

	n = 1,497 census tracts	
Group	N	%
Urban Census Tracts	896	59.9
Rural Census Tracts	601	40.1
Food Deserts	270	18.0
Urban Food Deserts	239	16.0
Rural Food Deserts	31	2.1
Any Census Tracts with at least 1 Farmers' Market Present	121	8.1

Findings of Chi-Square Test Independence Analysis

It was hypothesized that food desert census tracts in Tennessee were more likely to have at least one farmers' market than non-food desert census tracts. As shown in Table 2, 25 (9.3%) food desert census tracts (n = 270) had at least one farmers' market present (see Figure 4). With respect to the food desert census tract variable, the chi-square test of independence obtained was 0.614. With 1 degree of freedom and a significance level (p-value) of 0.433, which fell well above the 0.05 alpha level, there was no significant difference between the frequency of food deserts census tracts and non-food desert census tracts with at least one farmers' market present.

It was also hypothesized that urban food desert census tracts in Tennessee were more likely to have at least one farmers' market present than rural food desert census tracts. Of the 25 food desert census tracts with at least one farmers' market present, 23 (92.0%) were urban food desert census tracts and 2 (8.0%) were rural food desert census tracts. With respect to the type of food desert census tract (urban versus rural) variable, the chi-square test of independence

obtained was 0.329. With 1 degree of freedom and a significance level (p-value) of 0.750, which was greater than the 0.05 alpha level, the difference between the observed and expected values were not significant (Table 2). It was concluded that there was not a significant difference between the frequency of urban and rural food desert census tracts with at least one farmers' market present. In other words, the presence of farmers' markets was independent from the type of food desert census tracts. Although, this analysis included a small sample size of those food desert census tracts with at least one farmers' market present, more urban food desert census tracts (n = 25) had at least one farmers' market present in comparison to rural food desert census tracts (n = 2) (Table 2). Figure 5 shows the distribution of farmer's markets across the state of Tennessee within urban and rural food desert census tracts.

Table 2:

Chi-Square Test of Independence Analysis of Food Desert Census Tracts, by Type of Food Desert Census Tracts and the Presence of at Least One Farmers' Market

Variable		Presence of at Least 1 Farmers' Market		Total	$\chi2(i) = x, p = \alpha$
		No	Yes		
Rural Food Deserts Census Tracts	n	29	2	31	$\chi2(1) = 0.329^a$ p = 0.750
	%	93.5	6.5		
Urban Food Deserts Census Tracts	n	216	23	239	
	%	90.4	9.6		
All Food Deserts Census Tracts	n	245	25	270	$\chi2(1) = 0.614^b$ p = 0.433
	%	90.7	9.3		

a. 25.0% of the cells had an expected count less than 10. The minimum expected count was 2.87.
b. 0.0% of the cells had an expected count less than 10. The minimum expected count was 21.82.

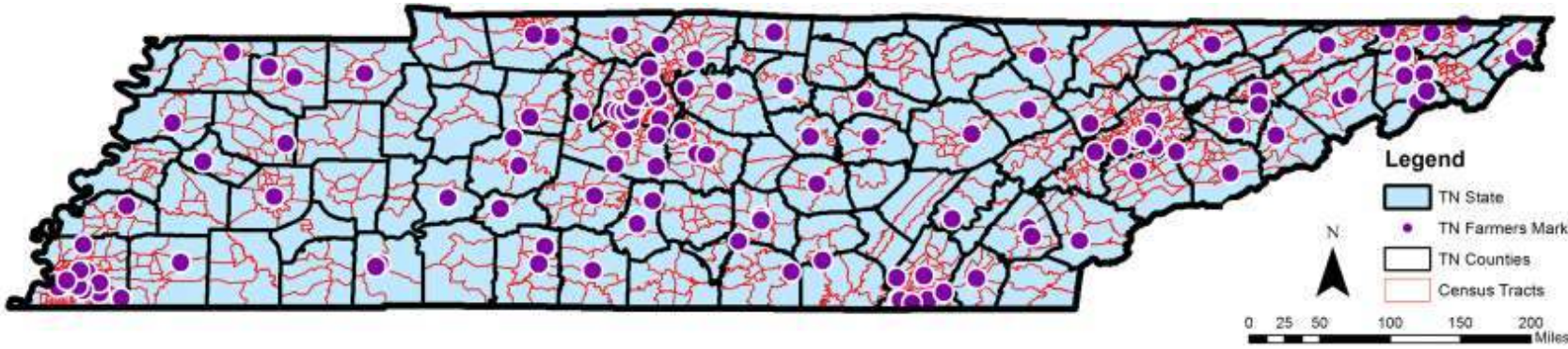

Figure 3: *Distribution of Farmers' Markets Across Tennessee Census Tracts*
(United States Department of Agriculture, 2015a, 2017d)

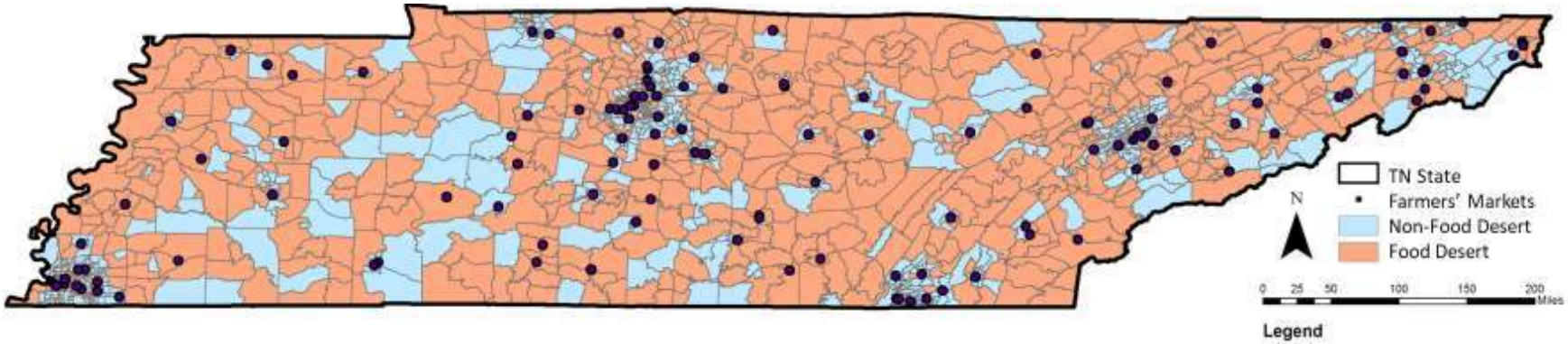

Figure 4: *Distribution of Farmers' Markets Across Non-Food Desert Census Tracts and Food Desert Census Tracts*
(United States Department of Agriculture, 2015a, 2017d)

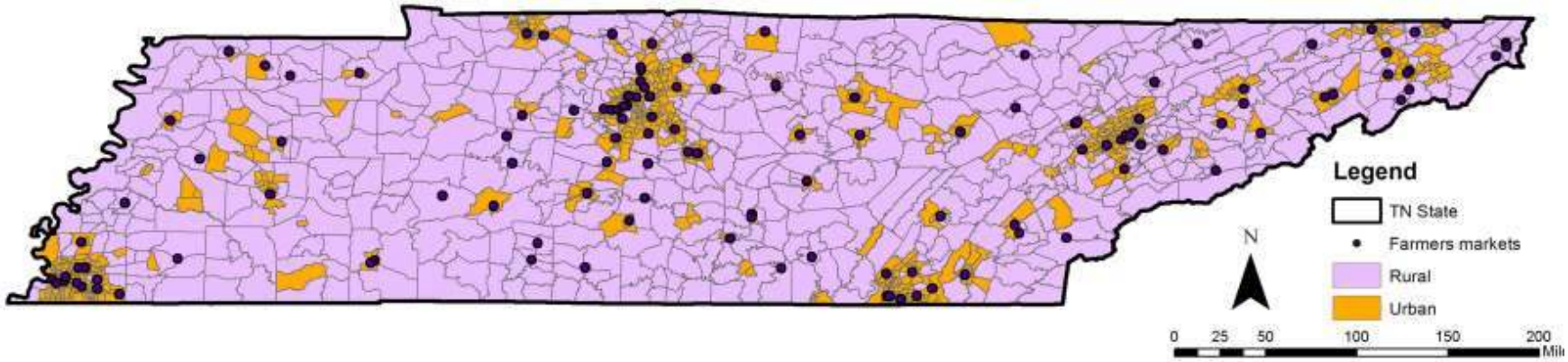

Figure 5: *Distribution of Farmers' Markets Across Urban and Rural Food Desert Census Tracts* (United States Department of Agriculture, 2015a, 2017d)

Research Aim #2

Description of Data: Demographics for Census Tracts (N=121) with Farmers' Markets

There were 130 farmers' markets located throughout 121 Tennessee census tracts (see Appendix A). The total population estimate of census tracks with farmers' markets was 546,722, which represented 8.4% of the state's population (n = 6,499,615). The gender and age demographics of Tennessee census tracts with at least one farmers' market present were similar to those of census tracts without farmers' markets and the entire state of Tennessee. Specifically, of these 121 Tennessee census tracts, 51.4% of the population were female (48.6% were male) and 72.9% of the population were over the age of 18, as shown in Table 3.

There were racial differences among census tracts with farmers' markets, those without farmers' markets, and the entire state. Among those census tracts with at least one farmers' market present, 84.2% of the population was Caucasian compared to the census tracts without farmers' markets (77.3%) and the state (77.8%). Educational attainment was lower in those census tracts with a farmers' market present in comparison to other census tracts. Additionally, there was an 8.79% unemployment rate in these 121 Tennessee census tracts compared to the state's 9.16% unemployment rate. Lastly, 19.1% of residents living in these 121 census tracks (Tennessee: 17.2%) lived below the federal poverty level. This information is depicted in Table 3.

Table 3:

Summary Sociodemographic Data for Census tracts with Farmers' Markets (n = 121) and Census Tracts Without Farmers Markets (n = 1376)

	TN Census Tracts (n = 1,497)		TN Census Tracts without Farmers' Markets (n = 1,376)		TN Census Tracts with at Least 1 Farmers' Market (n = 121)	
	Total Estimate	%	Total Estimate	%	Total Estimate	%
Total Population	6,499,615	X	5,952,893	X	546,722	X
Gender						
Male	3,167,756	48.7	2,902,118	48.8	265,638	48.6
Female	3,331,859	51.3	3,050,775	51.2	281,084	51.4
Age						
Under 18 years	1,468,964	22.6	1,353,871	22.7	115,093	21.1
18 to 34 years	1,395,441	21.5	1,282,003	21.5	113,438	20.7
35 to 64 years	2,552,597	39.3	2,346,218	39.4	206,379	37.7
65 years and over	922,350	14.2	843,330	14.2	79,020	14.5
Race/Ethnicity						
Caucasian	5,059,894	77.8	4,599,351	77.3	460,543	84.2
Black or African American	1,091,070	16.8	1,030,150	17.3	60,920	11.1
American Indian/Alaska Native	17,802	0.3	16,737	0.3	1,065	0.2
Asian	102,027	1.6	95,877	1.6	6,150	1.1
Native Hawaiian/Pacific Islander	3,323	0.1	3,196	0.1	127	0.0
Some other race	96,739	1.5	90,477	1.5	6,262	1.1
Two or more races	128,760	2.0	117,105	2.0	11,655	2.1
Hispanic/Latino	320,090	4.9	298,397	5.0	21,666	4.0
Educational Attainment by Age Group						
Population 18 to 24 years:	626,693	X	562,812	X	63,881	X
Less than high school graduate	79,014	12.6	72,118	12.8	6,896	10.8
High school graduate/GED	223,494	35.7	202,613	36.0	20,881	32.7
Some college or associate's degree	269,234	43.0	237,856	42.3	31,378	49.1
Bachelor's degree or higher	54,951	8.8	50,225	8.9	4,726	7.4
Population 25 years and over:	4,380,036	X	4,014,421	X	365,615	X
Less than 9th grade	246,828	5.6	223,046	5.6	23,782	6.5
9th to 12th grade, no diploma	389,310	8.9	355,840	8.9	33,470	9.2
High school graduate/GED	1,445,466	33.0	1,323,973	33.0	121,493	33.2
Some college, no degree	918,673	21.0	848,083	21.1	70,590	19.3
Associate's degree	287,483	6.6	265,943	6.6	21,540	5.9
Bachelor's degree	696,512	15.9	637,401	15.9	59,111	16.2
Graduate or professional degree	395,764	9.0	360,135	9.0	35,629	9.7
Poverty, Income, Assistance, Employment						
Population below poverty level	1,117,594	17.2	1,013,348	17.0	104,246	19.1
Household Median income ($)	$47,328	X	$47,427	X	$46,192	X
Population on cash public assistance/SNAP	441,390	X	399,286	X	42,104	X
Employment status (age 16 and over)	3,134,230	X	2,885,986	X	248,244	X
Unemployment Rate	X	9.16	X	9.19	X	8.79

An '(X)' means that the estimate is not applicable or not available.

Findings of Chi-Square Test of Independence Analysis

It was hypothesized that Tennessee farmers' markets located in areas (census tracts) with low SES were more likely to accept benefits from USDA food assistance programs in comparison to those farmers' markets located in areas (census tracts) with high SES. Approximately, 700 (46.8%) of the 1,497 census tracts in Tennessee were identified as low-socioeconomic status (SES) areas (high-SES: 797 or 53.2%). As previously mentioned, only 121 census tracts had at least one farmers' market present. Of 130 Tennessee farmers' markets, 45 (34.6%) accepted any type of government food assistance benefit. This information is depicted in Table 4 and Figure 6. Of those, 39 (86.7%) markets accepted SNAP benefits, 6 accepted (13.3%) WIC benefits, and 7 (15.6%) accepted SFMNP benefits (see Appendix B). It is important to note that these percentages do not add up to 100%, because some markets accepted more than one type of benefit.

With respect to the acceptance of any of the three government food assistance program benefits and its relationship to census tracts' SES, the chi-square test of independence obtained was 0.362. With 1 degree of freedom and a significance level (p-value) of 0.548, which fell above the 0.05 alpha level, the difference between the observed and expected values were not significant. Since the p-value was greater than the chosen significant level ($a = 0.05$), the null hypothesis was not rejected. No significant difference was found between farmers' market acceptance and non-acceptance of any 3 of the government food assistance program benefits if present within a low-SES or high-SES census tract. Farmers' markets acceptance of food assistance benefits was independent of census tracts' SES. Figure 7 shows the distribution of farmer's markets across the state of Tennessee within low-SES and high-SES census tracts.

Table 4:

Chi-square Test of Independence Analysis of Farmers' Markets Acceptance of Any the Three Food Assistance Program (i.e. SNAP, WIC/FMNP, SFMNP) Benefits Based Upon the Farmers' Markets Location within a Low-SES or High-SES Census Track

Variable		Farmers' markets who accepted any 3 government food assistance programs' benefits		Total	$\chi 2(i) = x, p = \alpha$
		No	Yes		
Low-SES Census Tracts	n	35	21	56	$\chi 2(1) = 0.362^a$ $p = 0.548$
	%	62.5	37.5		
High-SES Census Tracts	n	50	24	74	
	%	67.6	32.4		
Total	n	85	45	130	
	%	65.4	34.6		

a. 0.0% of the cells had an expected count less than 10. The minimum expected count was 18.48.

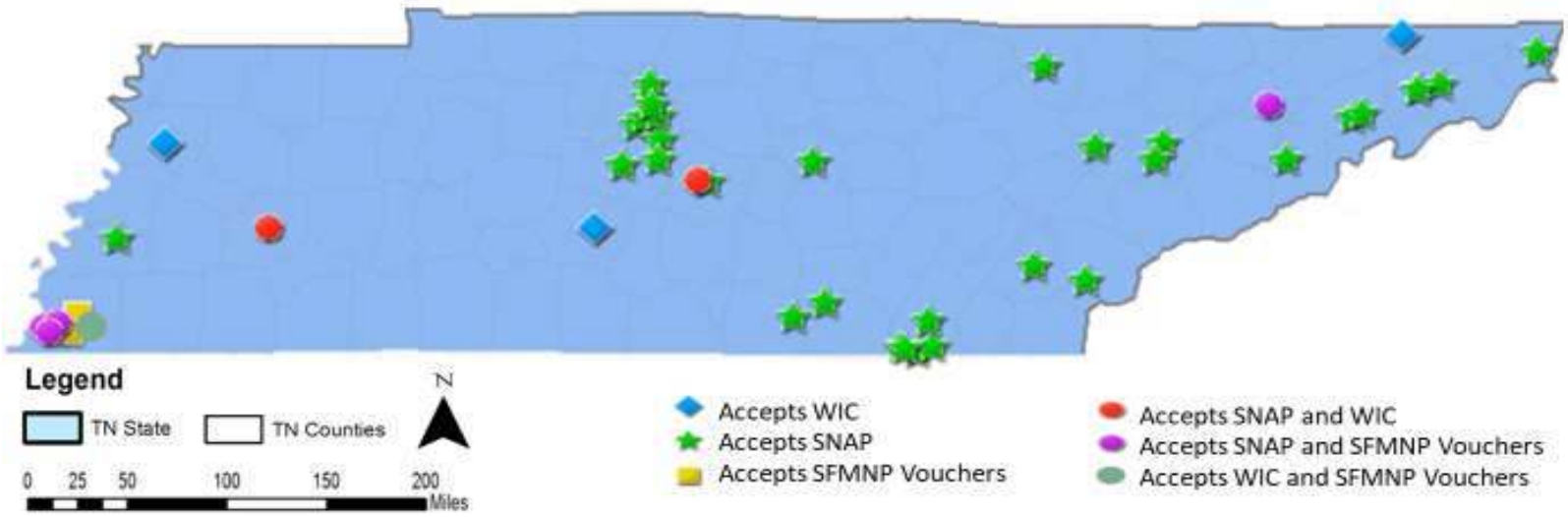

Figure 6: *Distribution of Farmers' Markets Across Tennessee and their Acceptance of WIC, SFMNP, SNAP or a Combination of All Program Benefits* (United States Department of Agriculture, 2015a, 2017d)

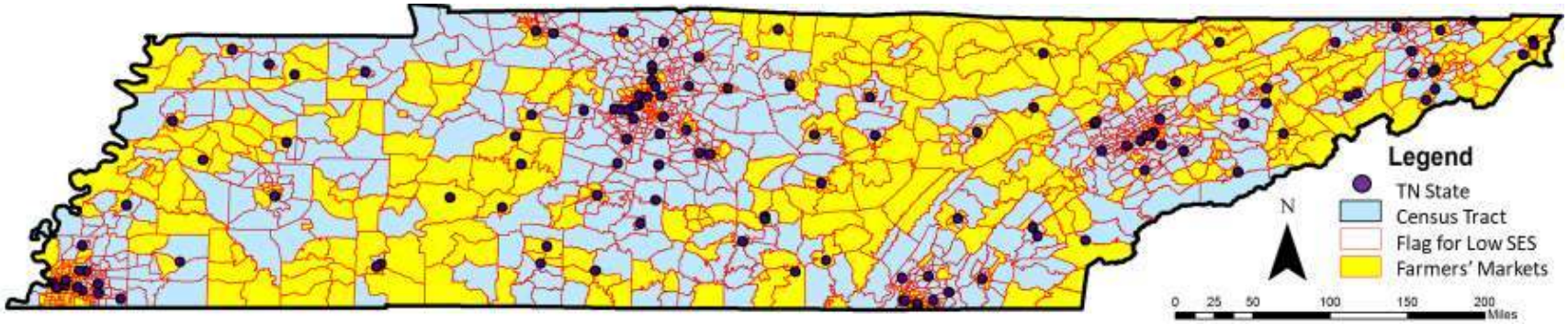

Figure 7: *Distribution of Farmer's Markets Across the Tennessee Within Low-SES Census Tracts* (United States Department of Agriculture, 2015a, 2017d)

CHAPTER 5

DISCUSSION

Summary

The overarching goal of this research was to assess the relationship between the presence of farmers' markets, the markets participation in USDA food assistance programs (SNAP, WIC, and SFMNP), and the presence of these markets within Tennessee food desert census tracts. Findings from this study did coincide with previous literature in regards to market locations in urban areas. This study found that farmers' markets were clustered in major metropolitan, urban census tracts, and few of these tracts were designated as food deserts. Only 25 (9.3%) food deserts had at least one farmers' market present, in which 23 were urban food desert census tracts and 2 were rural food desert census tracts. Previous literature also suggested that areas with low SES were more likely to have farmers' markets that accepted benefits from food assistance programs. However, this study found than many markets in Tennessee did not accept benefits from food assistance programs. Specifically, less than 28.0% of Tennessee farmers' markets accepted any type of food assistance benefit. At the time of this study, only 45 (34.6%) Tennessee farmers' markets accepted those benefits, and 24 of these markets were located in high-SES census tracts.

This research assessed spatial distribution of Tennessee farmers' markets, specifically focusing on the relationship with census tracts, food deserts and USDA food assistant programs. Upon completion of this study, the researcher discovered that many farmers' markets were not

located in food deserts. This study also provided a snapshot of the spatial inequality of farmers' markets throughout Tennessee.

Application of the Theoretical Framework

This study used the Model of Community Nutrition Environments, which conceptualized how healthy behaviors are determined by environmental and policy-level factors. This model was used to assess the relationship between the presence of farmers' markets, the acceptance of USDA food assistance benefits, and location within food deserts.

Farmers' Markets as a Community Resource

This study's findings were similar to the study completed in Georgia, in which few farmers' markets participated in food assistance programs (Brace et al., 2016). Specifically, likelihood of Tennessee farmers' markets accepting SNAP, WIC, or SFMNP benefits was substantially lower in areas of low-SES (i.e. less than 35.0% of farmers' markets accepted benefits from any UDSA government food assistance program). Not accepting benefits from these programs may act as a barrier for those who live in food deserts and areas of low-SES to access healthy, fresh options being sold at farmers' markets.

The findings from this study are valuable for considering ways in which farmers' markets fit into Tennessee's food landscape, and methods to improve access to fresh, healthier options. In promoting farmers' markets and their acceptance of USDA food assistance benefits, the government must consider how farmers' markets contribute to improving healthy food accessibility and affordability. Therefore, farmers' markets should be used as a community resource, which could lead to a decrease in obesity rates and improve access to healthy, fresh

foods in Tennessee. In summary, within Tennessee, those who reside in food deserts and depend on food assistance programs have little access to foods being sold at farmers' markets due to the lack of participation in USDA food assistance programs.

Spatial Methods and the Relationship Between Food Deserts and Farmers' Markets

Food insecurity and food assistance utilization have increased significantly within the last 10 years. Previous literature has shown differences in the distribution of food outlets and food assistance programs in rural and urban areas (Anderson & Burau, 2015; Brace et al., 2016; Coleman-Jensen et al., 2016; Mccracken et al., 2012; Waity, 2016; Yanamandra et al., 2015). This study successfully used spatial methods to analyze the relationship between food deserts and farmers' markets.

This study's findings were similar to studies completed in Arizona, Georgia, Texas, and Washington (Anderson & Burau, 2015; Brace et al., 2016; Mccracken et al., 2012; Yanamandra et al., 2015). Each of these studies found that farmers' markets were more likely to be in urban areas as opposed to rural areas, as is the case for Tennessee farmers' markets. Specifically, this study found farmers' markets were clustered in urban census tracts, or major metropolitan areas, near one another, yet many of those markets were not located in USDA-identified food desert census tracts. Less than 21.0% of the Tennessee farmers' markets were in food deserts census tracts.

Farmers' markets located in urban and rural census tracts face considerably different obstacles in providing nutritious food in a way that minimizes inequality of access. When farmers' markets are near each other, this may lead to competition when attempting to acquire

and maintain vendors and customers. Such competition could cause farmers' markets to be placed in suboptimal communities, and this placement of markets could hinder possible gains in increasing access to healthy foods (Anderson & Burau, 2015; Brace et al., 2016). Additionally, farmers' markets in rural areas face barriers when attempting to keep farmers local, as well as having markets present that actively accept food assistance benefits.

There is also potential in using farmers markets to increase healthy food access throughout food deserts (Mccracken et al., 2012). Given that Tennessee farmers' markets were clustered in urban areas, which tended to not be food deserts, the need for markets to accept food assistance benefits was low. However, residents who are receiving food assistance and live in rural areas should be afforded the opportunity to purchased healthy, fresh options at farmers' markets. To achieve this, farmers' markets should become more accessible throughout the state and its food deserts. This would require farmers' markets to be established throughout the state so that these resources exist outside of the major metropolitan areas. Secondly, assistance and training should be given to all state farmers' markets so the markets can become certified to accept SNAP, WIC, and SFMNP benefits. Although farmers' markets are not the only solution to increasing food access, it is important to understand the role of farmers' markets within the food landscape. This would allow for improved healthy food access throughout Tennessee.

The Benefits and Capacity of USDA Data

This study used several datasets to examine issues related to food access as conceptualized in the study's theoretical framework, which addressed multiple levels of influence related to food access and the acceptance of USDA government benefits. Data sources used for this study included the 2015 USDA Food Access Research Atlas and the 2017 USDA

Farmers Market Directory. Although both datasets are self-reported, these sources have allowed researchers to analyze large, random samples easily to possibly generalize the results to a larger population. Using these datasets also affords researchers the opportunity to examine many variables.

Recall that the Food Access Research Atlas compiled census tract food desert designations for the United States, 2010 Census population data, and 2011-2015 American Community Survey (ACS) data. The Atlas data was useful for this study because it has monitored trends in local areas, and afforded researchers the opportunity to make comparisons between various communities. Additionally, it has enabled the annual study of small and scattered populations. The Farmers Market Directory data was useful for this study because it is currently the only national farmers' market directory available on a consistent basis. The use of these two datasets in this study increased the validity of the study, complemented and verified one another, and reduced the impact of bias.

Defining Food Deserts

The 2008 Farm Bill directed the USDA to conduct a study of food deserts in the US to evaluate their incidence and prevalence, to categorize characteristics and factors causing food deserts and their effect on populations, and to offer recommendations to alleviate the issue (National Research Council (US), 2009). Prior to this study, the Farm Bill referred to food deserts as locations within the United States that have limited access to affordable and nutritious food, which are comprised of predominately lower-income communities (National Research Council (US), 2009). However, this definition was rather ambiguous, lacking specific measures, which could relate to time, price, and distance. A food desert is now defined as a low-income

census tract where either a significant number or share of residents have low access to a supermarket or large grocery store (United States Department of Agriculture, 2017g). Furthermore, census tracts are defined "as low income when least 20.0% of the people have income at or below the federal poverty levels for family size, or where median family income for the tract is at or below 80.0% of the surrounding area's median family income" (United States Department of Agriculture, 2017g). Lastly, census tracts may qualify as low access if at least 500 persons or 33.0% of their population live more than 1 mile (urban) or 10 miles from a major food retailer (United States Department of Agriculture, 2017g). It is important to note that a census tract can be identified either as low income or low access; however, a census tract must meet all the aforementioned criteria to be considered a food desert.

As it stands today, food deserts are only defined in terms of a share of a census tract population's proximity to a major supermarket or larger grocery store. However, the current definition of a food desert does not consider other opportunities of healthy food retail within census tracts, such as a farmers' market. Although, a small sample of food desert census tracts in Tennessee had at least one farmers' market present, findings from this study will assist in suggesting a change to the current USDA definition of food deserts. This change should expand on the locations where healthy food options can be purchased. For example, if a farmers' market is in an area of low-income without a major supermarket present, then that area should not be designated a food desert. Additionally, because farmers' markets are often seasonal establishments, this definition should include food hubs, farm stands, community gardens, soup kitchens, or even backpack programs. If such definition changes are made, then the frequency of food deserts would decrease, and residents would be afforded the opportunity to purchase healthy and fresh options from many locations.

Study Limitations

This study has several limitations. First, the sample in this analysis consisted of only those farmers' markets listed in the USDA's online directory. The USDA Farmers Market Directory is a self-reported and cross-sectional data source, which only includes those markets registered with the USDA. Due to this, the directory may have been missing data from this database, which causes it to not be a comprehensive listing of all farmers' markets across Tennessee. Unfortunately, it has been difficult to obtain data from smaller, informal farmers' markets and farm stands because these locations are often temporary or moving to newer locations with greater economic opportunities. This study placed a great deal of dependence on the USDA's National Farmers' Market Directory, which also posed a study limitation. However, this effort by the USDA has been the most extensive and persistent mechanism for keeping up with national farmers' market data. This study used the USDA Farmers' Market Directory data because it was the only representative sample of Tennessee farmers' markets that could be used for evaluating each markets' geographic setting in relation to the associated economic and demographic data.

This research also included 5-year estimate (ACS) sociodemographic data used to establish the Food Desert Research Atlas, which also attributed to underrepresentation of the population. The primary drawback of this data was that it was also self-reported. Another drawback of ACS, when compared to the census data, was that it was based upon a sample instead of the entire United States population; thus, resulting in margins of error. Because this study's primary region of focus was the state of Tennessee, the geographic units and ACS sample size was even smaller. Thereby, the margin of error within the data increased.

Additionally, multi-year estimates of ACS data did not provide a snapshot view of census tracts' sociodemographics. For this reason, this research did not compare data from overlapping periods to track trends over time, and used the most current version of the USDA Food Access Research Atlas – which comprised on 2011-2015 ACS and 2010 Census data. Therefore, caution was used when interpreting sociodemographic estimates for Tennessee census tracts.

Next, it is important to note that the term "food desert" has existed not without problems. By outlining an area using census tract boundaries, this study has abstracted the idea of food access. For example, it is possible that a census tract has a flourishing urban garden system, or a robust network of food trucks, but no supermarket or farmers' markets. Therefore, by labeling a census tract a food desert, this research may have overlooked other important community food resources.

Finally, the statistical analyses at the census tract level were limited by the small sample size of farmers' markets within food deserts, farmers' markets who accepted any three of the USDA food assistance benefits, and farmers' markets located within census tracts with a low-SES. Therefore, this study should not be generalized to other states, and further investigation involving a larger scale of geographic inclusion is needed to infer that these results would reflect other diverse populations and geographies. For example, one may want to assess the relationship among famers' markets, food deserts, and the acceptance of government food assistance program benefits among multiple states in a single geographic region or greater. It is further suggested that this study becomes longitudinal to assess the influence of time, population, and geographic changes. Using a longitudinal study would postulate a greater understanding of trends in food

deserts and advance the capability of generalizing the results of this research to a greater population and other geographic areas.

Conclusion

Findings from this study will contribute to public health and current literature, supporting the need for all farmers' markets to accept USDA food assistance program benefits and expansion of the term 'food deserts'. The findings presented within this work have also provided basis for further investigation of community and socioeconomic factors that determine where farmers' markets are established, and what food assistance programs are most beneficial for those areas in which the markets are located. Additionally, based upon this study's outcomes and findings from the literature on food access and farmers' markets, future steps are crucial to ensure farmers' markets increase access to healthy foods. These recommendations, while exclusive in part to Tennessee, may prove beneficial to other states and cities, as they contemplate moving forward with farmers' markets and their acceptance of government benefits as a strategy for improving food access. These recommendations include not only policy recommendations, but future research recommendations.

Future research should extend over multiple years to establish trends and illustrate a more thorough representation of issues related to food access in Tennessee and among farmers' markets. This would include establishing a Tennessee-specific inventory of farmers' markets through primary data collection methods, which would entail gathering evidence about the establishment of farmers' markets in food deserts, an update on locations, and current food assistance program participation. Future research would also include interviewing market managers, vendors, consumers, and community leaders to determine difficulties related to the

creation of farmers' markets in both rural and urban food deserts and the barriers to food assistance program participation. These types of studies would inadvertently provide the researcher with a sample size larger than that of the Farmers' Market Directory as it currently stands, and would provide the necessary information needed for communities to lessen any issues related to healthy food access.

Understanding the difficulties faced when establishing food assistance programs at farmer's markets located in food deserts would allow leaders to develop and implement policies to diminish such issues. Upon an increased understanding of these barriers, advocates can push for polices that would allow government entities to promote healthy eating through the integration of supplementary federal nutrition assistance programs at farmers' markets. This would increase the awareness and demand for more farmers' markets to accept food assistance benefits.

These recommendations have provided a specific course of action in which policy and research could reinforce farmers' markets and food assistance programs as interventions to increase access to healthy foods through strategic placement in food deserts and acceptance of food assistance program benefits. The intricacies of healthy food accessibility as discussed throughout this work have suggested that implementing these recommendations will not single-handedly reverse the increasing rates of obesity and cardiovascular diseases that affect the health and well-being of Tennessee families. This is demonstrated through the Model of Community Nutrition Environments and was developed because the food environment is complex, with multilevel factors influence eating behaviors. The study only focused on two of many interventions, farmers' markets and USDA food assistance programs. However, when used

together to alleviate food insecurity and decrease food deserts thorough assessment, preparation, and coordination, healthy food access can be improved.

Overall, the acceptance of SNAP, WIC, and SFMNP vouchers at farmers' markets affords families with the assistance necessary to provide nutritious meals to their families. However, the full benefits of these government food assistance programs could be used more effectively and efficiently if all farmers' markets located in Tennessee's food deserts and non-food deserts would accept such benefits. This would provide healthier options to beneficiaries, and stimulate the local economy by bringing needed government funding into food deserts.

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APPENDICES

Appendix A

Tennessee Census Tracts, Urban Versus Rural, Food Deserts, Farmers' Markets

Census Tracts	County	Farmers Market	Urban	Food Desert
47001020400	Anderson	Winter Farmers Market by Grow Oak Ridge	Yes	Yes
47009010600	Blount	Maryville Farmers Market - Saturdays	Yes	No
47011010500	Bradley	Bradley County Farmers Market	Yes	Yes
47021070402	Cheatham	Kingston Springs Farmers & Artisans Market	No	No
47025970700	Claiborne	Tri-State Farmers Market	No	No
47029920600	Cocke	Appalachian (Newport) Farmers Market of Cocke County TN	No	No
47031970500	Coffee	Coffee County Farmers Market	Yes	Yes
47031970600	Coffee	Manchester Locally Grown online farmers' market	No	No
47031970801	Coffee	Tullahoma Locally Grown Market	Yes	No
47033961300	Crockett	Crockett Farmers Market at Maury City	No	No
47035970400	Cumberland	Cumberland County Farmers Market	Yes	Yes
47037017100	Davidson	12 South Farmers Market	Yes	No
47037010701	Davidson	Amqui Station Farmers Market	Yes	No
47037019300	Davidson	East Nashville Farmers Market	Yes	No
47037015628	Davidson	Farmers Market at the Crossings	Yes	No
47037018602	Davidson	Forest Hills UMC Farmers Market	Yes	No
47037010301	Davidson	Goodlettsville Farmers Market	Yes	No
47037015300	Davidson	Nashville F.A.R.M I	Yes	No
47037018601	Davidson	Nashville F.A.R.M. II	No	No
47037018000	Davidson	Nashville F.A.R.M. III	Yes	No
47037017500	Davidson	Nashville F.A.R.M. IV	Yes	No
47037019400	Davidson	Nashville Farmers' Market	Yes	No
47037010106	Davidson	White's Creek Organic Farmers Market	No	No
47041920200	DeKalb	DeKalb Farmers Market	Yes	Yes
47043060602	Dickson	Dickson County Farmers Market	No	No
47045964400	Dyer	Main Street Dyersburg Farmers Market	Yes	Yes
47047060501	Fayette	Fayette County Farmers Market	No	No
47051960800	Franklin	Milan Farmers' Market	No	No
47051960700	Franklin	South Cumberland Farmers Market	No	No
47055920200	Giles	Giles County Farmers Market	No	No
47059090400	Greene	Depot Street Farmers Market	Yes	No

Census Tracts	County	Farmers Market	Urban	Food Desert
47059090300	Greene	Greeneville Farmers Market, Inc.	Yes	No
47061955300	Grundy	Grundy County/Tracy City Farmers Market	No	No
47063100300	Hamblen	Morristown Farmers Market	Yes	Yes
47065002800	Hamilton	Brainerd Farmers Market	Yes	No
47065002000	Hamilton	Chattanooga Market	Yes	No
47065001800	Hamilton	Lookout Farmers Market	Yes	No
47065012400	Hamilton	Main Street Farmers Market	Yes	No
47065011201	Hamilton	Ooltewah Farmers Market	Yes	No
47065011002	Hamilton	Signal Mountain Farmers' Market	Yes	No
47065010413	Hamilton	St Albans Hixson Market	Yes	No
47071920300	Hardin	Hardin County Farmers Garden Trade Day	Yes	No
47071920400	Hardin	River City Farmers Market	Yes	Yes
47073050301	Hawkins	Rogersville Farmers Market	Yes	Yes
47077975400	Henderson	Henderson County Farmers Market	No	No
47079969500	Henry	Henry County Farmers Market	Yes	No
47081950301	Hickman	Farmers Market at River Park - Centerville	No	No
47081950500	Hickman	Kedron Farmers Market	No	Yes
47089070700	Jefferson	Dandridge Farmers Market	Yes	No
47089070100	Jefferson	East Tennessee Regional Food Distribution	No	No
47091956200	Johnson	Shull's Farmer and Gardener Co-op	No	Yes
47091956300	Johnson	The Garden Barn Farmers Market	No	No
47093005811	Knox	Dixie Lee Farmers Market	Yes	No
47093002600	Knox	Knoxville Farmers Market -Laurel	Yes	Yes
47093005707	Knox	Knoxville Farmers Market- Ebenezer Road	Yes	No
47093007100	Knox	Knoxville Farmers Market- Lakeshore	Yes	No
47093005603	Knox	Marble Springs Farmers Market	Yes	No
47093004300	Knox	New Harvest Park Farmers Market	Yes	No
47093000100	Knox	The Market Square Farmers' Market	Yes	No
47093000902	Knox	UT Farmers Market	Yes	No
47099960501	Lawrence	Lawrence County Farmers Market	No	No
47099960300	Lawrence	Plowboy Produce Auction & Wholesale Farmers Market	No	No
47101970200	Lewis	The Farmers Market at Hohenwald	Yes	Yes
47111970300	Macon	Macon County Farmers Market	Yes	Yes
47113000800	Madison	West TN Farmer's Market	Yes	Yes

Census Tracts	County	Farmers Market	Urban	Food Desert
47117955100	Marshall	Henry Horton State Park Farmers Market	No	No
47117955200	Marshall	Marshall County Farmers Market	Yes	No
47119010400	Maury	Columbia Fresh Farmers Market	Yes	Yes
47107970401	McMinn	Athens Farmers Market at Market Park	No	No
47107970200	McMinn	McMinn County Farmers Market	Yes	Yes
47123925501	Monroe	Monroe County Farmers' Markets- Tellico Plains	No	No
47125100700	Montgomery	Montgomery County Farmers Market	Yes	No
47125100100	Montgomery	The Clarksville Downtown Market	Yes	No
47129110300	Morgan	Morgan County Farmers Market	No	No
47131965500	Obion	Obion County Farmers Market	No	No
47135930200	Perry	Perry County Farmers Market	No	No
47141000500	Putnam	Cookeville Farmers Market	Yes	No
47143975401	Rhea	Dayton Farmers Market	Yes	Yes
47147080500	Robertson	Robertson County Farmer's Market	No	No
47149040902	Rutherford	Rutherford County Farmers' Market	Yes	No
47149040305	Rutherford	Smyrna Farmers Market	Yes	No
47149041600	Rutherford	Stones River Market	Yes	No
47151975200	Scott	Scott County Farmers' Market	No	No
47155081102	Sevier	Gatlinburg Farmers Market	No	No
47155080300	Sevier	Seymour Farmers Market	Yes	No
47157980400	Shelby	Agricenter International Farmers Market	No	No
47157009500	Shelby	All Saints' Farmers Market	Yes	No
47157020622	Shelby	Bartlett Station Farmers Market	Yes	No
47157021611	Shelby	Collierville Farmers Market	Yes	No
47157006600	Shelby	Cooper Young Community Farmers Market	Yes	No
47157021342	Shelby	Farm Park Farmer's Market	Yes	No
47157008500	Shelby	Farmers' Market at the Garden	Yes	No
47157004300	Shelby	Memphis Farmers Market	Yes	No
47157020300	Shelby	Millington Farmers' Market	Yes	Yes
47157001600	Shelby	Overton Park Community Farmers Market	Yes	No
47157020542	Shelby	Seven Harvest Farmers Market	Yes	No
47157005900	Shelby	South Memphis Farmers Market	Yes	Yes
47159975200	Smith	Smith County Fruit & Vegetable Association F M	No	No
47163043402	Sullivan	Blountville Farmer's Market	No	No

Census Tracts	County	Farmers Market	Urban	Food Desert
47163040200	Sullivan	Kingsport Farmers Market	Yes	No
47163042701	Sullivan	State Street Farmers Market	Yes	No
47165020700	Sumner	Gallatin Farmers Market	Yes	Yes
47165020405	Sumner	White House Farmers Market	No	No
47167040700	Tipton	Covington Court Square Farmers Market	Yes	No
47171080400	Unicoi	Erwin/Unicoi County Farmers Market	Yes	No
47171080300	Unicoi	Town of Unicoi Farmers' Market	No	No
47173040100	Union	Union County Farmers' Market	No	No
47177930600	Warren	Martin Area Food Fair	Yes	Yes
47179061500	Washington	Appalachian Farmers' Market	Yes	No
47179060100	Washington	Johnson City Farmers Market	Yes	No
47179061702	Washington	Jonesborough Farmers Market	Yes	No
47179060700	Washington	The Farmers Market at East Tennessee State University	Yes	No
47183968400	Weakley	Dresden Farmers Market	No	No
47183968203	Weakley	Martin Area Food Fair	Yes	Yes
47185935400	White	White County Farmers Market	Yes	Yes
47187051100	Williamson	Farmers Market in the Grove	No	No
47187050702	Williamson	Franklin Farmers Market	No	No
47187050102	Williamson	Nolensville Farmer's Market	Yes	No
47187051201	Williamson	Thompson's Station Farmers Market	No	No
47189030700	Wilson	Lebanon Farmers Market	Yes	Yes
47189030309	Wilson	Mt. Juliet Farmers' Market	Yes	No

Appendix B

TN Farmers' Markets, and USDA Food Assistance Benefits Accepted

Accepts SFMNP (n=7)	Accepts SNAP (n=39)	Accept SNAP and WIC (n=2)	Accepts SNAP and SFMNP (n=4)	Accepts WIC and SFMNP (n=1)
1. Agricenter International Farmers Market	1. 12 South Farmers Market	1. Rutherford County Farmers' Market	1. Memphis Farmers Market	1. Agricenter International Farmers Market
2. Bartlett Station Farmers Market	2. Amqui Station Farmers Market	2. West TN Farmer's Market	2. Morristown Farmers Market	
3. Farmers' Market at the Garden	3. Appalachian (Newport) Farmers Market of Cocke County TN		3. Overton Park Community Farmers Market	
4. Memphis Farmers Market	4. Athens Farmers Market at Market Park		4. South Memphis Farmers Market	
5. Morristown Farmers Market	5. Boone Street Market			
6. Overton Park Community Farmers Market	6. Brainerd Farmers Market			
7. South Memphis Farmers Market	7. Chattanooga Market			
	8. Cooper Young Community Farmers Market			
	9. Covington Court Square Farmers Market			
	10. DeKalb Farmers Market			
	11. Depot Street Farmers Market			
	12. East Nashville Farmers Market			
	13. Farmers Market at the Crossings			
	14. Franklin Farmers Market			
	15. Goodlettsville Farmers Market			
	16. Greeneville Farmers Market, Inc.			
	17. Grundy County/Tracy City Farmers Market			
	18. Hip Donelson Community Farmers Market			
	19. Hip Donelson Community Farmers Market @ Music Valley			
	20. Johnson City Farmers Market			
	21. Johnson County Farmers Market			
	22. Jonesborough Farmers Market			
	23. Lookout Farmers Market			
	24. Main Street Farmers Market			
	25. Memphis Farmers Market			
	26. Monroe County Farmers' Markets- Tellico Plains			
	27. Morristown Farmers Market			
	28. New Harvest Park Farmers Market			
	29. Nolensville Farmer's Market			
	30. Overton Park Community Farmers Market			
	31. Rutherford County Farmers' Market			
	32. Scott County Farmers' Market			
	33. South Cumberland Farmers Market			
	34. South Memphis Farmers Market			
	35. St Albans Hixson Market			
	36. Stones River Market			
	37. The Market Square Farmers' Market			
	38. West TN Farmer's Market			
	39. Winter Farmers Market by Grow Oak Ridge			

VITA

TWANDA D. WADLINGTON

Personal Data:	Date of Birth: October 7, 1985 Place of Birth: Memphis, Tennessee
Education:	DrPH, Community and Behavioral Health, East Tennessee State University, Johnson City, Tennessee, 2017 M.P.H., Community Health, East Tennessee State University, Johnson City, Tennessee, 2010 Epidemiology Certificate, East Tennessee State University, Johnson City, Tennessee, 2010 B.A., Biology, Fisk University, Nashville, Tennessee, 2008 Public School, Memphis, Tennessee, 2004
Professional Experience:	Research Associate, University of Memphis, Memphis, Tennessee, July 2017 – Present Adjunct Professor, LeMoyne-Owen College Memphis, Tennessee, September 2013 – Present Regional Campaign Manager, American Heart/Stroke Association, Memphis, Tennessee & DeSoto County, Mississippi, May 2015 – July 2017 Campus Director, LeMoyne-Owen College/MeHarry Medical College HBCU Wellness Project, Memphis, Tennessee, October 2013 – November 2015 West and Jackson-Madison Regional Coalition Coordinator, Tennessee Cancer Coalition, Jackson, Tennessee, July 2013 – June 2015 Mentor, TNAchieves, Memphis, Tennessee, October 2013 – January 2015 Consultant/Contractor, Tennessee Department of Health (Early Childhood Advisory Council, Nashville, Tennessee, August 2012 – July 2014 Graduate/Teaching Assistant, East Tennessee State University, College of Public Health, Johnson City, Tennessee, August 2009 – August 2013 Intern, Tennessee Department of Health's Division of Minority Health and Disparities Elimination's Institute for Health Communities Internship, Nashville, Tennessee, June 2012 – August 2012 Intern, Tennessee Department of Mental Health and Substance Abuse Services, Nashville, Tennessee, June 2012 – August 2012 Intern, Doctor of Public Health Practicum, Project Hope UK

and the Thoughtful Path: Munsieville, Munsieville, Gauteng Province, South Africa, June 2011 – May 2012

Intern, Kingsport Tomorrow, Kingsport, Tennessee, May 2010 – May 2011

Fellow, Dr. James A. Ferguson Emerging Infectious Diseases Fellowship Program with the Association of Minority Health Professions and Schools at the Center for Disease Control and Prevention, Atlanta, Georgia, May 27, 2009-August 31, 2009

Delegate, International Scholar Laureate Program (ISLP) Delegation on Medicine in South Africa, Cape Town, Johannesburg, and Hazyview, Summer 2007

Honors and Awards:

The National Scholars Honor Society, East Tennessee State University, 2011 – Present

Frist Global Scholar, East Tennessee State University, 2012 – Present

Golden Key International Honor Society, East Tennessee State University, 2008 – Present

Wykoff Scholarship, East Tennessee State University, 2012

Rural Health Association of Tennessee Annual Conference Poster Contest: 2nd Place, November 29, 2010

Divisions IV and VI of the Appalachian Student Research Forum: 1st Place, April 8, 2010